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LETTERS

Not a Knot

SIRS:

I wonder whether your readers may find as much interest as I have in this remarkable tree—a maple I believe—located in the Piseco Lake area of the Adirondack State Forest.

A friend has rendered the opinion that the tree may have been struck with an ax or other implement when it was younger and that it produced an excessive formation of bark in the effort to overcome the injury or infection that resulted. Do you concur?

GLEN DALTON.

Scotia, N. Y.

The literature indicates that galls and burls and other abnormalities are caused by various things. Some are pathological, involving bacteria and fungi; some are physiological, due possibly to nutritional disturbances; some are caused by parasitic plants (mistletoe), forming "witches brooms"; and some have been attributed to insects. It would be impossible to state what agent caused the formation shown in this photograph.—ED.

King or Gangster?

SIRS:

To Mr. McHugh, the mole may be "Little King of the Underworld" (NATURAL HISTORY, Oct., 1949), but to me and my neighbors, he is something unprintable. I have about 180 acres for moles to tunnel through, and if the "Little King" would keep out of my flower beds and front lawn—less than an acre—all would be well. But no, he won't play that way. I do not suppose Mr. McHugh would help me in my efforts to exterminate his pets or, to put it in a nicer way, confine them to their share of my property—a nice 179 acres.

There is one point I think I should make. Mr. McHugh says, "Prized daffodils are felled." Our experience down here is just the reverse. Daffodils, jonquils, and narcissus (I don't know which is generic) are grown here commercially. "The Little King" won't touch the bulbs. In fact, the way to protect a bed of fancy tulips is to plant a row of jonquils around it (cheaper than using rat wire). The mole dislikes them so much he won't go through them after tulips, which he loves. My boys insist that the mole works only on flood tide. Anything in this?

While I am at it, I might as well present another problem. Some mornings I find my lawn full of holes, two or three inches deep, as though made with a pointed stick. I blamed the ground hogs, but Henry, my outside boy, says it is brother skunk, and he has set a wire trap, baited with a piece of chicken, to catch the raider next time he goes grub hunting. Henry has had no luck to date, which suits me, for the trap is entirely too close to my bedroom window for comfort. Henry agrees to dispose of the catch in person (his stomach is much stronger than mine), but I still hope he catches a ground hog.

W. C. KING, JR.

Gloucester, Va.

Tom McHugh, the author of "Little King of the Underworld," offers the following comments:

The distastefulness of daffodils to

NOTICE—Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on these pages will be paid for at $3.00 each, with full credit to the photographer. Return postage must be included.

moles is a very interesting point, since I have discovered no records that this creature is such an epicure. It is entirely possible, however, that the list of plants unpalatable to various animals is indeed a large one.

Even the fact that moles eat tulips is a fairly controversial subject. Examination of the stomachs of several hundred eastern moles has proved that the bulk of their diet is earthworms and white grubs. The western species of moles are quite different, however, since they consume a much greater quantity of plant material. They will readily eat tulips, bulbous irises, carrots, parsnips, and beans.

Much damage to garden greens is erroneously blamed on the mole. After our little king splits the earth into a maze of underground tunnels, he is no longer the sole owner of these galleries. Numerous other small mammals, especially shrews, meadow mice, and deer mice, find the mole's tunnels very convenient highways for traffic and for marauding. These trespassers hurt the reputation of the mole, for he is accused of much of the injury to seeds, grains, roots, and tubers that actually is done by other intruders.

A study of tooth marks on the damaged products will bear out this statement. Since the mole's short teeth are not meant for gnawing, the damaged roots are mangled rather than cut clean. Work done by rodents can be detected by the sharp tooth marks.

These intruders also bring other trouble to the mole in his supposedly safe underground castle. Voracious shrews are a constant threat to nestling young, and invading snakes may be one of the few predators of the mole.

The idea that moles work only at flood tide is quite erroneous. The earth-cleaving habits of this animal require an enormous amount of energy, which in turn depends on a gluttonous appetite. Periods of rest are abruptly ended by pains of hunger, and the mole surges forth again through the soil in a never-ending hunt for food. He has no time clock to punch and works intermittently day and night.

As Mr. King can prove, moles may become very annoying pests and must, therefore, be removed. Trapping is the most satisfactory method of controlling them, but it is successful only if the habits of the mole are carefully considered. Advantage can be taken of the fact that the mole is not suspicious of dirt blocking the runway. This habit provides opportunity for using a specially designed trap that straddles the runway with the trigger pan resting on the dirt blockade. As the animal travels through his tunnel and pushes through the barrier, the arms of the trap are sprung and catch him.

If hose connections are available, moles may be drowned out by flooding the runways. This works best during April, when the undeveloped young are most likely to be in the nest.

Since the mole tends to avoid obnoxious substances, repellents may be placed in runways. Lye, paradichlorobenzene, and naphthalene seem most effective. The ridges should be opened with a small stick at intervals of about ten feet. After a teaspoonful of one of these materials is inserted, close the opening carefully. Applications should be repeated whenever sections of old runways show signs of being used or when any new ridges appear.

Fencing small areas with woven wire or concrete is practicable where valuable plants require special protection. Galvanized hardware cloth with three meshes to the inch will exclude mice as well as moles. Concrete walls one inch or more thick have been found cheaper in the long run.

The holes in Mr. King's lawn are more than likely due to skunks, which like to uproot patches of sod in their search for the grubs that lie just underneath.

Bees and Pilot Whales

SIRS:

Your letter from Dr. E. P. Andrews on insects that make a short cut to the nectar in flowers reminded me of proof of such pilfering offered by photographs taken some years ago. Herbert F. Schwarz, in commenting on Dr. Andrews' letter, mentions the plant genus *Aconitum* as being the prey of a European bumblebee. Our handsome perennial larkspurs (*Delphinium*) are close relatives of the aconites, and their longer nectariferous spurs make them difficult of access to all except long-tongued insects. In my garden, bumblebees regularly chewed a short cut to the nectar supply, as this photograph (*at left*) attests. I, too, noted that honeybees often took advantage of such perforations, once opened.

The interesting article on pilot whales (September NATURAL HISTORY) arrived the same week that I viewed a friend's amateur movie taken of a school of "blackfish" stranded on Lieutenant's Island, near Wellfleet, Massachusetts.

An attempt was repeatedly made to "launch" smaller individuals of this stranded school. A "blackfish" would be worked into navigable water and headed seaward, but in each instance, it turned about and hopelessly rebeached itself.

More amazing was the fact that during the launching maneuvers it was found that if a bather mounted the "blackfish," it made an excellent and docile steed. Some of the best pictures in the film showed a person "cruising" through the waters of Wellfleet Bay mounted on a pilot whale! It seemed that the blowhole served a double purpose—as an invagi-

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

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From a Kodachrome by Jack Breed

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The only insect to shed its skin after acquiring fully developed wings

Whistling Wings.....Walker Van Riper and Robert J. Niedrach 44
Though he may not sing a note, you will hear the Broad-tailed Hummingbird before you see him

You will find Natural History Magazine indexed in *Readers' Guide to Periodical Literature* in your library

THE COVER THIS MONTH

Traveling by automobile along State Route 16 in New Hampshire, thousands of visitors every year pass the lovely grove of white birches that gives you a touch of winter on this month's cover. Framing a stunning view of Mt. Chocorua, these birches make one of the most photogenic foregrounds to be found anywhere in a much photographed state. Mt. Chocorua, 3475 feet high, is named for an old Indian chief, of the early Pequawket Tribe. One of the more southerly of the White Mountains, it is often considered the most beautiful peak in New England.

In summertime, the deep blue of Chocorua Lake sparkles at the mountain's base. Eighteen miles to the north is the popular resort area of North Conway, and fifteen miles south is Lake Winnepesaukee. Thus, Mt. Chocorua and its birches are at the hub of a scenic vacationland.

Jack Breed caught our striking cover vista on a blustery February afternoon when the temperature was near zero. The exposure, on 5x7-inch Ektachrome daylight film, was 1/5th second at F18.

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YOUR NEW BOOKS

Margaret Mead: Male and Female • Peru Tropical Aquariums • Indians • Poppy

From Cave Painting to Comic Strip

---------- by Lancelot Hogben

Chanticleer Press, $5.00, 288 pp.
20 pp. full color, 211 black-and-white illusts.

THIS kaleidoscope of human communication is a delight both to the eye and to the mind. Ably organized and well written is this story of man's self-education by means of calendars, alphabets, number systems, mechanical and anatomical drawings, musical notation, pictures, and photographs. All this in a book of less than 300 pages would appear to be but wishful thinking, not capable of execution. However, biologist and medical statistician Hogben and visual aid expert Marie Neurath have combined their talents to achieve a high degree of success in this venture. It is the illustrations that make it possible to maintain a reasonable coherence in presenting this panorama of man's attempts to communicate with his fellows. This is no attempt to belittle the author's skill in popularization. Hogben has already established himself as an expositor of considerable effectiveness with his earlier works, *Mathematics for the Million* and *Science for the Citizen.*

Cave paintings start this story, and comic strips come in near the end, but in between is the amazing history of man's development of the various media of visual communication.

Especially pertinent is the final chapter on *The Internationalization of Free Speech.* Hogben presents a concept well worth considering. It is simply this. The complex, nervous, and suspicious world of today calls for easy, clearly understood communication between the peoples of the various nations. Some kind of international language or rather international communication is needed. It should be a medium easily learned and independent of all grammatical apparatus with the exception of word order. It should overstep the usual language barriers. Hogben suggests a picture language. When you finish this book of his you are inclined to hold with him. When he shows you how civilizations have failed when their means of communication proved inadequate, when he demonstrates how ponderous and clumsy some of these inadequate means of communication were, and when he demonstrates by some fine isotypes how clear picture language can be, you begin to get his point. Hogben feels that today we are in danger of being outstripped by the narrow advances of our specialists. The knowledge and judgment of the people must somehow catch up with our rapidly expanding and complex world of science. Hogben simply states that we might overcome this lag by means of the international language of pictures that "can be used to unite mankind as well as to entertain it."

JOHN R. SAUNDERS

Male and Female

---------- by Margaret Mead

William Morrow, $5.00

477 pp.

IN this book of 477 pages, the celebrated woman anthropologist undertakes to explain the physical basis of the sexes, division of labor between the sexes, the influence of parental attitudes on psychological development, and sex customs in the United States, as well as woman's proper role in human society. Much of the evidence comes from her own extensive studies of several South Sea societies. But not all. Everything is grist to Dr. Mead's mill—the advertising methods of American business, the child-rearing practices of ancient Japan, the kinds of movies produced in Hollywood, and the songs that were popular in grandfather's day.

The thesis, as I understand it, is that our society has failed to make full use of special gifts of the feminine sex and thus denied itself many benefits. By virtue of the biological differences between the sexes and between their childhood experiences, as well as differences in their reproductive experiences, women see the world in different ways than men. Dr. Mead reasons that by recognizing and cultivating the special superiorities of both sexes, a better world can be built.

Dr. Mead embraces the currently fashionable theory of "character types" for different societies. She explains the variation in concepts of masculinity or femininity primarily in terms of the attitudes of adults toward children. Her interpretation is frankly psychoanalytical. For example, among the Arapesh a baby is treated as "a soft, vulnerable, precious little object, to be protected, fed and cherished." It is offered the breast frequently even though it may not be hungry. Never does the infant have to seize, bite, or hold the mother's nipple. Infants are carried in bark slings and have no need to grasp or hold on.

The Arapesh child grows up, therefore, with a passive, receptive attitude toward life. The female has little trouble in carrying this general attitude over into adult sexual relations. "To transfer an attitude of pleasant expectancy from mouth to vulva, of soft, optimistic retentiveness, requires very little shift in attitude." But males reared in this fashion are so lacking in habits of dominance and aggression that they fit into the role of a husband only with the greatest difficulty. They are unwarlike, easily conquered, and enslaved. Even in hunting, they reveal the effects of early childhood experience, for instead of stalking and killing game, they set traps and wait until an animal falls in.

Two points are stressed again and again in *Male and Female.* First, that the adult personality is to a large degree shaped and patterned by the child-rearing practices of the culture; and second, that the transformation from male infant to adult man usually involves a much more difficult psychological adjustment than the change from female infant to woman, regardless of the particular society involved.

Our own society, according to Dr. Mead, is suffering from emotional inflation. Our levels of aspiration so greatly exceed any possibility of actual attainment that we live in a state of chronic anxiety. This generalization applies to all phases of our lives, but Dr. Mead is here

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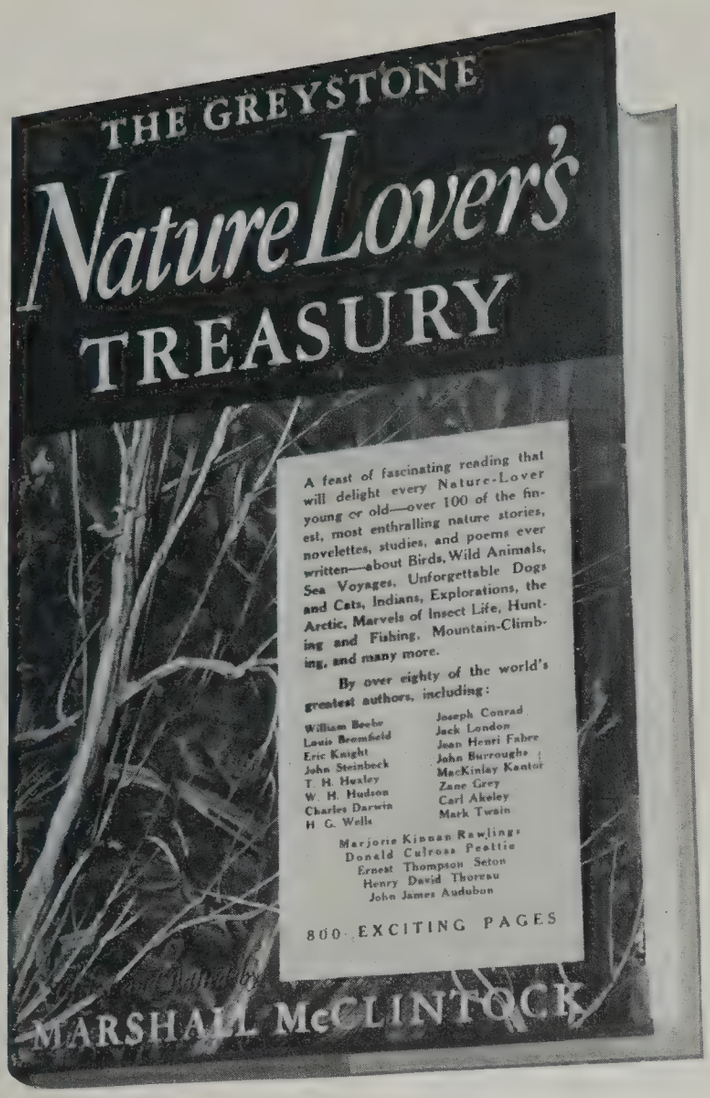
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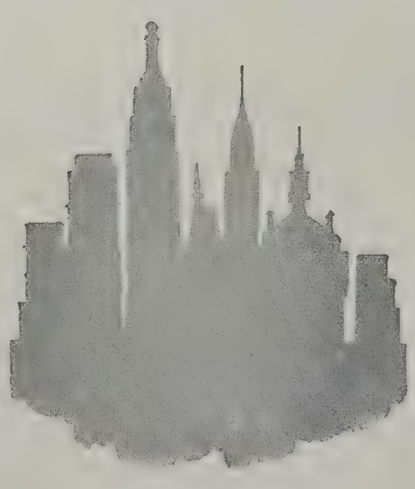

primarily concerned with the ways in which it affects relations between the sexes. In a chapter entitled "Can Marriage Be for Life," she points out the discrepancy between idealized "till death do us part" sentiments and the statistics on divorce and separation. It is unrealistic and unethical, according to Dr. Mead, for the State to permit any two people to marry merely because they have mutually consented to do so, and then to raise legal barriers against the dissolution of unsuccessful marital partnerships.

This book is too full of ideas to lend itself to condensation or even adequate representation in a short review. It is, first of all, a thoughtful, penetrating analysis, and the facts it contains should not be recounted except within the author's frame of reference. Nor can a reviewer label the work as "good" or "poor" and let it go at that. Too much depends upon one's willingness to accept the author's use of the facts. In the beginning of the book Dr. Mead explicitly states that she is presenting only her own point of view and that others might employ the same facts to support a different theory. This declaration does not, however, relieve her of the responsibility of discriminating for the reader between fact and intuition, between data and interpretation. And sometimes she seems to represent as factual, things that are, to say the least, open to question.

Personal reactions of a reviewer usually reflect differences or similarities between his tastes and those of the author. For example, many of the psychoanalytical interpretations in *Male and Female* strike the present writer as extreme. But in all fairness it should be added that this may represent the generalization of a negative attitude toward much that is included in the orthodox analytic point of view. A second negative reaction rests upon the feeling that Dr. Mead's literary style is unnecessarily involved and repetitious. Having stated a general point, she sometimes proceeds to particularize with one example after another until the reader becomes impatient or bored.

In the chapter entitled "Human Fatherhood Is a Social Invention"—a title, incidentally, that is apt to startle biologically-minded readers—Dr. Mead ingeniously weaves together a great deal of material to show that the human male's tendency to nurture his wife and children depends upon learning or social inheritance and is not "instinctive." The female's impulse to feed and protect her offspring is, in contrast, rooted in her biological inheritance. Several objections can be raised against this point of view. In contradiction to Dr. Mead's statement, care of the female and the young by the male is not limited to *Homo sapiens.* It appears, for instance, in lower mammals, such as certain species of mice, and in some carnivora, including wolves. Furthermore, male chimpanzees living in their natural state do protect immature members of the group. Dr. Henry Nissen has recorded instances in which the ruling male of an ape group picked up and carried to safety young animals that were threatened with danger.

In the main these are carping criticisms. As has been stated above, the meat of this book is in the ideas it contains instead of the facts it presents. The ideas are, as are all of Dr. Mead's, stimulating and instructive. Whether one quarrels with her interpretation or finds it completely adequate, no one can read her writings and fail to profit thereby.

FRANK A. BEACH

THREE WORLDS OF PERU

by Frances Toor

Crown Publishers, $3.50
239 pp., 75 photos

ALTHOUGH this book is organized and written as a travel journal rather than as a conventional guide, it is likely that it will be employed from the latter point of view, and I am, therefore, criticizing it with that usage in mind. Unlike her predecessors in the field, Miss Toor covered Peru systematically in her travels, and her observations are presented in accordance with the three principal geographical regions of the country, the coast, the *sierra,* and the *montaña.* That the highlands are emphasized is only natural, since without question the high Andes hold the greatest store for the foreign visitor.

It is clear that the author, although impressed by Peru's great archaeological monuments, is far more interested in the present-day population than in the past. History and archaeology, therefore, receive no systematic treatment, which is, perhaps, as well, since Peru's colorful

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history and imposing ruins have been described time and again. The Indians, Mestizos, and Whites, on the other hand, receive considerable attention, and some aspects of the contemporary scene—especially fiestas—are described in some detail. For the benefit of the tourist a calendar of major fiestas has been included. Of particular interest, however, even to the specialist, are Miss Toor's first-hand descriptions of ceremonies and celebrations in out-of-the-way villages of the coast and highlands. But although the author appears to be a sensitive and accurate observer, her choice of informants is often uncritical, and she not infrequently goes astray in the matter of interpretation.

In spite of a number of irritating errors, however, each region of Peru is characterized with surprising accuracy and with attention to its special flavor and feeling tone. It is a pleasure to read a travel book by one who so honestly liked, sympathized with, and appreciated the country and the people.

HARRY TSCHOPIK, JR.

TROPICAL AQUARIUMS

---------- by Ian Harman

Illustrations by Humphrey Dakeyne

Sidgwick & Jackson Ltd., London, 10/6
168 pp., 54 drawings

THE tropical fish fancy has engendered its share of books purporting to explain the intricacies of tank management to the novice and the refinements of aquarium practice to the more experienced amateur. None of these has been completely successful, however, largely, we believe, because they have devoted too much space and effort to uncorrelated facts and not enough to the principles underlying the proper maintenance of small fishes in captivity. Not that the fancier needs, or wants, a book on the physiology or ecology of his pets! He does need, however, a general, more or less basic knowledge of the part played by the water, sand, plants, appurtenances, fishes, and other life in his aquarium. No author can hope to cover even a fraction of the exigencies that can arise—situations that can only be met by applying properly understood principles.

This book suffers from the same defects as its predecessors; not enough is said in its introductory chapters on how to set up and operate a tank. What *is* said is in general accurate enough. We might quarrel with the advice given to feed one's fishes several times a day, although this is good practice if minuscule enough amounts are given each time to avoid overfeeding. In common with the great majority of aquarists the author misunderstands the functions of plants in aquaria, believing that they serve to oxygenate the water.

The American aquarist will be interested in the contrivances upon which the austerity-ridden British fancier must depend for heat, light, and aeration, and will consider himself fortunate in having both the mechanical devices and the power to run them readily at his disposal.

JAMES W. ATZ

THE AWL-BIRDS

---------- by J. K. Stanford

The Devin-Adair Company, $2.00
90 pp., 28 illusts.

IN the populous home island of the British not a few species of birds have disappeared as a result of mistaken activities by gamekeepers, the draining of marshlands, and other pressures of human occupation. One of the birds that recently came back from the Continent to nest in England after more than a century is the graceful avocet, a shorebird with a thin upcurved bill like a cobbler's awl.

There was grave danger that "British-taken" avocet eggs would tempt covetous oölogists; hence special efforts were made to guard their nests. This much is fact. Mr. Stanford has dramatized the story and woven in many incidents typical of postwar Britain. The precious eggs, on the point of hatching, are saved from a predatory collector, and retribution comes upon the villain in appropriate but unexpected fashion. The tale is well conceived to arouse fervor for the protection of rare birds. Mr. Hughes's pen-and-ink sketches are an admirable complement.

JAMES P. CHAPIN

THE INDIANS OF THE SOUTHWEST

A Century of Development Under the United States

------ by Edward Everett Dale

University of Oklahoma Press, $4.00
283 pp., 16 plates, 5 maps

THIS book deals with an important and neglected aspect of United States history—the relations of the Federal Government with the Indians inhabiting that vast territory acquired by treaty from Mexico in 1848. It is a bitter history and, until very recently, one of broken pledges, shameful neglect, maladministration, and bloody warfare. The area covered extends from central New Mexico to central and southern California, once a wilderness of deserts and mountains peopled by Indian tribes of widely differing cultures.

Friends of the Indian, the author contends, are often prone to condemn the Indian Bureau, particularly during its formative years, for bungling and mismanagement. He shows, however, that in many instances—as during the gold boom in California—ineffective handling of Indian affairs must be blamed on the inherent difficulties of the task rather than upon any lack of good intentions.

In his eagerness to be fair, Mr. Dale speaks repeatedly of "definite objectives" and "established policy" of the government when discussing Indian administration from Grant's presidency to the early twentieth century. Yet any clear-cut aims and goals during this period are difficult to perceive. The plight of the landless Mission Indians was virtually ignored until cries from the California press made action inevitable, while Navaho and Pueblo administration was characterized by quarrels between military and civil officials and by graft and corruption on the part of political appointees.

Although the history is detailed and meticulous, it is history in the narrow sense, unrelieved by any deep understanding of the Indian cultures involved. Current problems are discussed almost exclusively from the administrative point of view, while pertinent recent literature on the Indians' attitudes and adjustments has been completely ignored. The author has, however, done an excellent job of assembling and editing important and inaccessible data from government archives, newspapers, and unpublished manuscripts.

HARRY TSCHOPIK, JR.

16MM SOUND MOTION PICTURES

----- by W. H. Offenhauser, Jr.

Interscience Publishers, $10.00
580 pp., 123 figs.

THOSE who are graduating beyond the usual 16mm motion picture camera to full sound moving picture equipment will be interested in this new book. It answers almost every conceivable question on the use of the various types of equipment and on the technical processes involved in the production of the finished film.—ED.

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▲ PRINCESS TE PUEA and your author on the steps of the meetinghouse at Ngaruawahia Pa

THE enormous stretches of the Pacific Ocean are becoming more and more of a laboratory for scientific research, due in large measure to the Pacific Science Congresses, which have been meeting in its various parts. Roughly spaced at three-year intervals, except for a longer war interruption, seven have now been held, in Hawaii, Australia, Japan, Java, British Columbia, California, and in 1949, New Zealand. The Eighth Pacific Science Congress will meet in the Philippines. The work that has been accomplished is tremendous and has led to far-reaching programs for current and future study.

All branches of science are included: zoology, oceanography, every kind of medical work, fisheries, agriculture and conservation, education, and more. The subject of anthropology could not fail to win

▼ THERE ARE MANY new Maori meetinghouses. The carving, by old men who know their trade, adheres strictly to traditional rules

➤ NO TWO PANELS of Maori carving are ever exactly alike. Eyes are made of paua shells. The pendant on the neck cord is a hei-tiki. Such hei-tikis are treasured heirlooms made of greenstone

Photos courtesy New Zealand Legation

ere Our Hosts

unusual visit with the natives of New Zealand
ı ancient and noble people whose cultural
rebirth has won them world-wide respect

By GRACE E. BARSTOW MURPHY

Photographs by Athelstan Spilhaus unless otherwise credited

particular interest, because the Pacific peoples from Hawaii to New Guinea fascinate everyone who thinks about them.

Modern anthropology has a new approach. The world's foremost anthropologists no longer treat the native like a butterfly on a pin or a squirrel in a cage. Rather, he is treated as a friend, and it is considered a privilege to approach him and to learn his way of life. That spirit prevailed at the sessions of the Congress that I attended in my capacity as delegate. I have never known livelier scientific discussion than that among the anthropological scholars of a score or more of nationalities gathered first in Auckland for a week and later in Christchurch for a second session.

In between these sessions, the various groups of scientific folk were sent traveling by the Government of New Zealand. Big, comfortable buses were supplied each group, each with a leader to keep us informed, follow the itinerary, and arrange for our comfort. It was science, but it was holiday. Holiday for scientific people generally means more science in a different garb.

The focal point of our eight-day anthropological tour lay in the person of Sir Peter Buck, who had come home after many years away. He is half Maori. He grew up among the Maoris like any other Maori boy. However, he went much further, after his graduation from college, than do most boys of any race. He became a full professor at Yale, without doubt the only one whose grandfather belonged to a cannibal tribe. He has held for many years the directorship of the great Bishop Museum in Honolulu. He is the most noted ethnologist in the study of Pacific peoples.

But in New Zealand, he is the loved member of his race. At mention of his name, Te Rangi Hiroa, to any Maori, smiles of pride and deep affection break forth. I have seen it happen many, many times. In his visit of 1949, he was the son, the brother, the father, of every Maori in New Zealand. Which, of course, meant fatted calves and cel-

Photo courtesy New Zealand Legation

▲ ONE OF OUR ROTORUA FRIENDS. Each of the ancestral weapons on the gate carvings is called a "mere"

▲ A JESTING DANCE with the long poi. Judging from the facial expressions, the singing in Maori is probably full of fun. Note the difference between the long poi and the short poi fastened at the belts of the flax skirts

ebrations. He must have visited nearly all the villages. As hospitality is part of education in Maori culture, the entertainment was superb. We pakehas, as the Maoris call our race, Sir Peter's friends and colleagues, were included. In village after village, dancing, feasting, speech-making, welcomed him, and us.

In each pa, the procedure and settings differed sufficiently to keep one's interest very alert, but the pattern was the same.

I use the word "pa" advisedly. In the old days, pa meant a fortified village, with an intricate system of ditches and barricades, often arranged on a hilltop. *Kainga* was the word for an unfortified village. Today, long after the time of need for such fortifications, many scholars use the word "pa" for the usual Maori village, of which there are hundreds in New Zealand.

Our party reached the first village, Ngaruawahia, at about eleven of a warm, sunny, midsummer, February morning. There were over twenty of us, three women and the others men. We were all excited at the unusual chance to enter into tribal customs practiced over centuries, to see such dances and share in such feasts.

We gathered outside the carved arched gateway, flanked with beds of brilliant flowers. The red ochre on the carving keeps troublesome forest spirits outside where they be-

▼ POI BALLS FLY in perfect synchronization. Only the old women in the villages have real tattooing on the chin and lips, but this woman has painted an old design on hers. Stout women are as light on their feet as girls

▲ FACIAL CONTORTIONS are an important part of Maori posture dancing. Tongues shoot out incredibly, and the whites of the eyes are made to look enormous. The old war dances were extremely terrifying

long. Every custom of the Maoris has some such explanation.

Against the mountains that are always the backdrop of New Zealand scenes, we could see inside on the village green a gleaming group of brown, half-naked warriors.

A chief detached himself and dashed toward us, brandishing a long and slender weapon, leaping, yelling, making faces, tongue out in defiance, eyes rolling. It was fearful. I almost ran. He was naked except for the swishing flax skirt that he wore over shorts.

He stopped in time. His anger turned to courteous pleasure. He began to lead us in. Again he whirled upon us, driving us back with his ancestral weapon, grimacing furiously. Again he turned and led us in. He joined the group of warriors. They did a leaping dance of welcome.

The feathered, spearlike club carried in this dance is a taiaha, used both ceremoniously and in actual fighting. Its technique was taught as carefully as that of sword or foil. Training in arms was ceaseless with the Maoris. A beginner learned to watch fixedly the big toe or the shoulder point of the adversary. The toe clenched downward, the shoulder showed a muscle movement a split second before a blow was to be delivered. The dance-trained warrior, never standing still, agile and light on feet, could leap aside. It is reported that when firearms came in, a Maori could sometimes dodge a bullet by a quick movement at the flash of the gun.

When the men finished their lively welcome, the mood changed, and the old women of the tribe, waving wreaths of leaves and branches, danced a tangi for the dead. We stood silently and quietly, our heads bowed. It must be pleasant to know that one will always be remembered, in affection, in one's Maori home.

After that short seriousness, everything was gay. We were led to benches on one side of the marae, or open space before the meeting-house, sitting in the sun at right angles to the porch that sheltered Sir Peter and his Lady. Our hosts sat opposite. Sir Peter sent for me, and I sat near him, more comfortable in shade. As soon as one dance stopped, another started. Nearly all were posture dances, called the haka. Their ability to express their ideas in motion is so great that one could almost

▼ THE RED OCHRE PAINT of the carved gates of the villages keeps out evil spirits. We would stand waiting till ushered in by dancers. The significance of the three-fingered hand is lost in the past. The protruding tongue symbolizes defiance

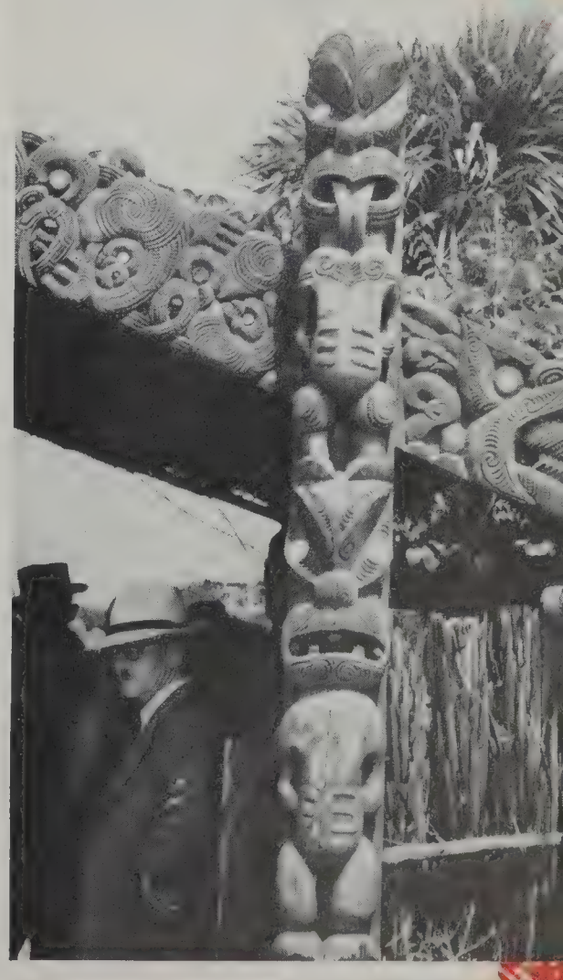


Photo courtesy New Zealand Legation

SIR PETER BUCK with the Governor-General, Sir Bernard Freyberg, V.C., at Government House, Wellington, on the occasion when Sir Peter was invested with the insignia K.C.M.G.

follow the meaning of the singing even though it was in soft-toned Maori. The men knelt on one knee, weapons on the ground, while the women came toward us in the perfect synchronization of their dancing. Rhythm flowed throughout their bodies, hands and feet, and all their muscles. Fingers added movement in a lovely grace.

The poi dances are done with two flax balls on a six- or eight-inch string, one in either hand. The dance called the long poi uses balls with strings perhaps two feet long. Whichever length is in use, the balls move in absolute precision and at lightning speed, over the shoulders, under the arms, crossed, uncrossed, in a maze of figures followed in accuracy by long lines of dancers. They are taught, of course, from childhood. A mistake made in the dance is traditionally bad luck. Their carefree, happy natures find outlet in this dancing. The older women join the young, full of fun and nonsense, light as air in spite of heavy pounds. Everybody dances, but the rules and patterns are followed in accepted discipline.

Each flax skirt takes months to make. The men's end above the knees, but the women's fall generally to the ankles, over full skirts. Nearly all wear headbands, often with feathers in them, their long black hair flying loose. The women's bodices are often bright with embroidered bands. At the Rotorua celebration a few days later, the costumes, though still Maori, were influenced by our modern stage. Skirts were short, and more emphasis was laid on color.

The designs of the skirts are dyed onto the flax. The parts to be colored are scraped, the rest left natural. The strands are soaked in a bark infusion and then buried in black mud, which stains the scraped parts. The sound of the fibers is delightful as the dancers move.

One leader of the women wore a feather robe—undoubtedly a treasured heirloom. The Maoris have never done weaving as we know it. They made material for clothes by finger-weaving strands of flax. In the feather cloaks, each feather was tied in place by hand. When one hears careless modern whites call the Maoris lazy, one wants to recommend a course of reading. Until the early settlers came, they had no time for laziness. They had to work hard.

When they arrived from hotter climates 600 years ago, their whole culture had to be readjusted to lower temperatures. They found New Zealand flax, tried out the different kinds, chose one, grew it with care, and learned to make their clothes. They had as hard a job with food. The tropical plants brought with them in their great canoes, such as breadfruit, would not grow in New Zealand. Only the *kumara*, or sweet potato, survived easily. Some taro grows in the North Island. They learned which native ferns were good to eat. They worked out a laborious system of agriculture. They had 27 names for 27 different kinds of soil. They learned the ways of unfamiliar birds and fishes and how to catch and preserve them. They became experts in everything they attempted. And life was dedicated to their art to such extent one wonders how their years were long enough to complete their work. Every war canoe was carved from end to end, taking years to build. The task of felling enormous trees with basalt and greenstone tools seems an impossible one.

That the Maoris lived in the Stone Age, like most Pacific peoples, knowing no metal until the beginning of the last century, seems to me to make their story one of the most surprising records in history. Metal has been taken for granted for so long throughout nearly all the world. To them, "greenstone" meant what "golden" does to us—a word carrying the thought of something precious: "a golden opportunity," the "greenstone door" to everlasting

peace. Greenstone is a jade almost as hard as steel. Its discovery in New Zealand was a rich one for the Maoris. Yet how they worked it into smooth, sharp, symmetrical tools, weapons, and ornaments, sometimes with carving on them, is one of the wonders of human attainment. Dr. Skinner, Director of the Otago Museum in Dunedin, spent hours of his busy days showing me the vast collections of the Maori greenstone. Many dancers wear greenstone tikis as jeweled ornaments, hanging from cords around the neck. They are shaped somewhat like human embryos. The significance of some of these things is lost in hazy history, as the Maoris had no writing of any sort for keeping records.

Such thoughts played through my mind as I watched the rhythm and infinite grace of the dancing, while a tiny child wandered about the marae, climbed up onto the porch, then onto Sir Peter's knee.

The dancing stopped. Speeches began. Through all the centuries, speeches made on the marae have been a most important part of Maori life. All the Maoris are orators. Their flowing, flowery language serves such purpose well. It is a Polynesian dialect, similar to Hawaiian and Tahitian. The speakers were wearing ordinary clothes. Each speech was translated, then answered by one of our own party. Sir Peter grew rapt in Maori, more casual in English. He told his people that though he had been away, he had worked throughout the years on Maori matters. He thanked them for their welcome. At one pa, he fell exuberantly into some haka steps. The speakers extolled his Lady for the support she had given him. They extolled the scientific folk in words that sometimes ran: "We always welcome the Government people. They are our contact with the outside world. It is to them we must offer our thanks for this opportunity of greeting the scientists . . . You, as our guests, represent to us our forebears who have departed. You were with our sons at the first World War and are instrumental in bringing with them peace to the world . . . Pakeha education has been felt in this district. May the scientists leave something of use to the Maori . . . Bring with you the baskets of knowledge from Io . . . You from the many islands of the Pacific and continents of the world, we are asking ourselves the reason for your visit to our district . . . Welcome to New Zealand! Welcome, and bring the knowledge from those places from which you come and share it with us. Our people have helped the world. You see their record. Welcome, good health and prosperity."

Our Dr. Ryerson, Chairman of our American delegation to the Congress, was charming in his handling of our thanks and tributes. The Fijian, Dutch, Indonesian, French, Australian, New Zealand scientists of our party, and the other Americans also caught the spirit of the friendly Maoris.

The many speeches finally over, our hosts lined up, and we passed by them, shaking hands. We entered the meetinghouse through the carved door.

I later went into many beautifully carved meetinghouses where there was no furniture at all beyond a few mats or mattresses on the floor. Originally, Maoris never had furniture. But in this one, envisioned by

THE SWISH of the flax skirt makes a vely sound to accompany the soft singg. This man's face is painted to look e "moko," or tattooing

Photo courtesy New Zealand Legation

➤ THE PAINFUL APPLICATION OF "MOKO," a custom taught to Maoris by their gods in dim history and followed till recent times

the Princess, Te Puea, who was about to join us, deep chairs and sofas, flower-covered tables and rugs, invited us to comfort for as long as we could stay. Taste and style were flawless. The arrangements were more homelike than is usually found in a room 80 feet long. The walls and rafters followed the intricate order of Maori architecture and design, with the one difference that there were many windows. Panels of woven flax in color separated the great carved panels, each of which differed from the other, yet all were similar in plan. Brilliant design in red, black, and white decorated the rafters. The long ridgepole was carved. Feather cloaks hung on the walls with ancestral weapons, and grass skirts served as curtains. The far end was blocked off as a small and very choice display of treasures.

As the Princess joined us among these colorful, luxurious appointments, we rose as a body to greet her.

She wore a bright-flowered calico blouse, which hung outside her long, black cotton skirt. She walked erect on the bare feet that have carried her forward, inspired by her vision, to a leadership of the Maori race. A black scarf half covered her soft white hair, accenting her wide mouth, large well-set brown eyes under strong brows, and her shapely nose and chin.

She had just been eulogized in speeches on the marae as the outstanding Maori of her age and generation. Her people had been disintegrated and disheartened. In her vision she was told to mold them together again, never giving up her goal.

She walked slowly, for she is not well. There was no pomp and circumstance of royal birth and no sign to separate her from the scores of brown-skinned Maoris with us in the whare runanga. No sign, did I say? There was a strength and knowledge of living in her face which should go with every such title as the Princess bears. To her sympathetic understanding, credit is given for the slow and difficult adjustment of the Maori to the pakeha world. She is called a striking example of what influential Maori leadership can be and what it can accomplish. A lesser race than hers would long ago have knuckled under to the impact of foreign aggression. There is intellect in the Maoris. Their system of communal living, coupled with an aristocracy, all without any economic striving, stressed and developed mental qualities.

Their ancient schools, called whare wananga, attended by the first men of the tribes, trained them in philosophy, religion, ritual, tapu. Their mythopoetic lore holds as great a sensitiveness to life and beauty as can be found in that of any race. Though they had no form of writing, their memories were trained to prodigious capacity. White men alive today have heard old Maoris chant 1400 names and stations of their ancestors. No mistake was permitted.

With such a history of minds revered and trained, it was not strange that the Young Maori Party arose out of the general disintegration of the race, a few decades ago. Men like Sir Ngata Apirana, Sir Peter Buck, and others joined together to block the downward path toward complete destruction. Population decrease stopped. Increase began. Hope awakened. These modern Maori intellectuals are educated in Te Aute College. It is hardly possible for untrained Europeans or Americans to comprehend the racial habits and the needs of so different a culture. In the educated Maoris there is combined an understanding of the best in both the races, whose difficult relations in New Zealand have always been colored by a mutual respect. It is significant that in 1948 the name of the government's Department of Native Affairs was changed to the Department of Maori Affairs. None of this means that problems are solved. There is still disease and poverty, bad housing, and bad feeling over land. It means, however, that the best men of both races are working toward well-chosen goals. It means that the time was ripe for good work to be accomplished by the Princess. She taught her people that they could not live in the memory of wrongs. She modified their attitude toward the Government in such matters as the Waikato land development schemes, teaching co-operation and its value. "Work with the Government, not against it," was the wisdom that she taught. She has raised money for homes for orphans and landless people in her own village, Ngaruawahia. The beauty of her village is due to her planning.

In 1925, Elsdon Best in his book, *The Maori,* wrote of the decadence of Maori art. In 1940, Professor I. L. G. Sutherland, who edited the compilation of papers called *The Maori People Today,* recorded the revival of Maori arts and crafts. These two books alone, both out of print but available in libraries, give a well-rounded understanding for those curious to know something of the situation.

The room that held us proved Te Puea's conviction that it is possible to unite modern comfort with Maori tradition and background. Housing is notoriously bad among the Maoris. She had four-room houses built, combining Maori materials, style, and construction with pakeha sanitation, at a quarter of the cost of a pakeha house. She knows what is essential to the Maori's culture and what are the demands of his different background. She knows his pride of race and his requirement of a communal existence, combined with an aristocracy of tribal chiefs. She knows his need of art, of humor, and of dancing, his mythopoetic lore and his pride of ancestry. She also knows his need of the benefits of white civilization. The upper class of Maoris from earliest times saw little difference between the cult of their Supreme Being, Io of the Hidden Face, and the doctrines of the missionaries. By means of such clear-eyed vision today as theirs was then, the race is being led to new confidence and attainment.

Generally, the meetinghouses consist of only one room. Te Puea's has several rooms, including a modern suite with bath, for guests.

We passed through to a dining room where lace-covered tables groaned under five times as much

Continued on page 48

HOME AGAIN: Canada Geese in flight formation over the Gaddy sanctuary

BACK-YARD Bird Sanctuary

The unique achievement of Lockhart Gaddy attracts thousands of visitors every season and shows that the greatest satisfaction lies in working *for* nature, not *against* it

By EDWIN D. NEFF

Photographs by HUGO H. SCHRODER

LOCKHART GADDY used to be a hunter.

Now he refuses to hunt.

He used to lie behind the cold, damp blinds of the Carolina marshes, gun in hand, waiting for the cry of the great gray geese sailing high across the moon. Later, if he was lucky, the Gaddys would dine on succulent roast goose flooded with rich goose gravy.

Now Lockhart Gaddy and his wife cannot abide roast goose. Yet less than an hour's walk from their farm near Ansonville, North Carolina, thousands of fat Canada geese paddle smugly about a great pond from October till March. Further, the Gaddys are feeding the geese these days!

Mr. Gaddy, you might say, has got a kind of religion. He no longer belongs to those bands of "sportsmen" who prefer to study Nature through a gunsight. Instead of hunting geese, he protects them. He has built the most unusual wild goose refuge to be found anywhere in the United States. It is known to bird lovers and the public throughout this country and in many foreign lands. Needless to say, the Lockhart Gaddy refuge has a wide reputation among geese.

That Mr. Gaddy's change of view came about accidentally is none the less to his credit. The fact remains that he is now a sensationally successful conservationist and is inspiring others to follow in his steps. Already, a neighbor has built a small goose refuge.

The state of North Carolina has given legal recognition to the Gaddy sanctuary, and hunters are forbidden within a half mile of the little spring-fed lake which Gaddy himself built and has twice enlarged.

◄ SINCE LOCKHART GADDY put away his shotgun in 1934, his little lake has become increasingly popular to wintering birds, and the world has stamped a beaten path to his door. Naturalists and camera fans have an unusual opportunity to study the birds at close range

▲ CLOSE-UP of two Canada Geese, one well out of the water

Gaddy's place is gathering a kind of fame as well as spreading the gospel of conservation. Thousands of visitors pour in over week ends and gladly pay for the rare wonder of seeing wild geese no farther away than you can throw an ear of corn. Mr. Gaddy makes little money on his admission charge of 25¢, because the geese eat 1200 to 1500 bushels of corn in a season.

This, then, is the story of what a single individual has done, even in these times of hustle and bustle, to bring the pageant of Nature to his doorstep.

The story begins nearly fifteen years ago, when Mrs. Gaddy's mother, Mrs. Pattie K. Ross, who loved to fish, suffered failing eyesight. It was no longer safe for her to fish the tricky current of near-by rivers, so Mr. Gaddy built a one-acre pond on his farm. Also using the pond were a number of tame geese, which Gaddy had used as live decoys in the days when the law permitted. Though these creatures had long since become corrupted by the easy life around the farm, they still echoed their age-old cry when wild geese were flying overhead.

One autumn day, Mr. Gaddy was surprised to discover that his decoys had called down nine wild Canada geese to the tiny fish pond. The wild ones decided to stay instead of moving south with the flocks, and actually remained all

➤ AS MANY AS 3000 visitors come to the Gaddy refuge on a Sunday. This singular spot is an urgent attraction to every nature-minded traveler on his way through North Carolina

winter. At first, of course, they zoomed off every time Gaddy got near the pond. They wouldn't touch the shelled corn he left for them. Finally, they came to accept corn on the cob, but only if the ears were mashed into the ground. Two months passed before the wild geese would allow Gaddy to approach the pond while they were around, and even then they remained on the opposite shore. That was in the fall of 1934.

The following year, the Gaddys found themselves glancing hopefully toward the sky every time a flock of geese passed by. Imagine their delight when 35 Canada geese suddenly detached themselves from formation and swooped down to the pond. The new winter visitors, however, were just as wary as the first nine. Whenever anyone approached the pond, they flew off or scuttled to the other side.

The third year the goose population of Gaddy's little pond rose to more than 100, and by the following year, nearly 500. The early comers must have inspired confidence, because the new birds were much more tolerant. They accepted food graciously and allowed themselves to be approached within a reasonable distance. From then on, the flocks increased every year, arriving by the first full moon in October and remaining until the first full moon in March. During the 1946-47 season, nearly 6000 of the great gray honkers were demanding reservations. The following summer, the number had leveled off a bit, but Mr. Gaddy expects the average to become about 6000 per season. During these years the number of human visitors to Gaddy's astonishing sanctuary also had increased, until now anywhere from 1500 on a bad-weather Sunday to twice that number in good weather can be counted on. Several hundred appear on weekdays. All this is small wonder, for the Gaddy pond is a photographer's paradise.

All varieties of flight shots are possible from close range. When a sudden movement startles the birds off the pond, a speed shot will record wings in every flying position. Groups of birds leaving shore can be snapped with tails toward the camera, displaying the prominent white markings seldom seen by the casual observer. Flocks coming in from foraging expeditions often stunt, performing sideslips, rolls, and all manner of aerial acrobatics.

As the little pond began to attract larger numbers of geese, Mr. Gaddy began to be troubled by shotgun artists, as well as cameramen. The huge concentration of geese drew hunters from all parts of the state, threatening the birds with mass slaughter whenever they left the pond. Finally, the State Legislature was persuaded to close the area to hunters within a half mile of the pond. This gave the birds a chance to gain a fairly safe altitude on the take-off before passing over dangerous country.

On moonlight nights, the wild geese leave the pond for distant feeding grounds, returning just before daybreak. When clouds obscure the moon, they wait until dawn for their flights.

They are still wary. Wild Canada geese are intelligent and will note the slightest change in their environment. If a visitor approaches from the pine woods instead of from the path leading to the Gaddy farmhouse, they become alarmed. Then the usual goose *yakity-yak* changes to a fearful cackle. If the visitor behaves himself and avoids sudden motions, however, the talk returns to conversational tone.

Once, a photographer who had been using a small camera switched to a large type which required a tripod. Instantly, the geese became suspicious and moved offshore. But within about a half hour they had decided the new gadget was harmless and began to move about freely once more. They have become quite friendly with the Gaddys, however, and will approach to within eight to ten feet. A visitor who is accompanied to the pond by Gaddy gets a much better reception than if he comes alone.

While Canada geese are by far the most numerous wildfowl on the Gaddy refuge, other species are seen from time to time. Several White-fronted and Snow Geese

➤ MOST OF THE AVIAN visitors are Canada Geese, but many other birds can be seen here, including some that are rarely observed in this part of the country

➤ BECAUSE PROTECTION is given the wild birds, they enjoy perfect confidence in their surroundings—until a strange dog or some unaccustomed activity sends them flying

have been observed, as well as Hutchins's Geese. Nine Blue Geese had arrived by October 29 last fall.

Various ducks winter with the geese. The Gaddys have seen Black Ducks, Ringnecks, Mallards, Shovelers, Redheads, Green-winged Teals, Pintails, Baldpates, Canvasbacks, Ruddy Ducks, Blue-winged Teals, Coots, and Grebes. But perhaps most astonishing, because only one other example appears to have been reported from North Carolina, was a Cinnamon Teal, a western bird, whose presence was vouched for by two competent bird students besides Mr. Gaddy.

During the past season, records have been broken. The first geese—a group of seventeen—arrived earlier than ever before, on September 22. By October 29 an estimated 3000 had arrived—the largest number ever to have gathered during October. By November 21, there were at least 5000.

One Barnacle Goose, a European bird, came last November. Dr. Broley, the famous eagle bander, who also vouched for its identity, stated that it was the first one he had ever seen in all his travels.

Shortly after Gaddy saw that his pond was definitely established on the Canada's Duncan Hines list, the U. S. Fish and Wildlife Service set up a banding cage at one end of the pond. As many as 100 geese have been trapped for banding at one time. Nearly 500 of them were banded in one season. Many of these geese at the Gaddy pond have been found wearing bands of the Jack Miner Sanctuary in Kingsville, Ontario.

Gaddy tells a story of banding a number of geese on January 12, 1945, after which some of the birds, still terrified, took flight. Four days later, two of the banded birds were shot in southern Illinois, 500 miles away. (Canada geese in flight average 30 to 50 miles per hour.) This was curious, not only because of the distance but because of the direction. The unfortunate geese had traveled 500 miles westward at a time of the year when they were supposed to be permanently settled in the wintering areas.

During the banding operations the geese were weighed and found

➤ SOME OF THE GEESE weigh as much as 11¾ pounds. They eat 1200 to 1500 bushels of corn in a season

▲ WHEN THE BIRDS LEAVE in March, a quiet descends over the Gaddy farm, but there is always excitement preparing for next season's winged pageant

to average 9½ pounds, though some weighed as little as 6½ and others as high as 11¾. Geese are apt to be belligerent when nesting. The nesting goose will allow a strange human to approach only so far; then it charges, hissing like a snake.

There are, of course, sanctuaries where Canada geese gather in much greater numbers than at the Gaddy farm, but the birds can be seen only through binoculars, and photography is difficult or impossible. At Gaddy's all the birds are concentrated in a three-acre area. The farthest birds are only a few hundred yards distant.

This no doubt accounts for the sanctuary's popularity. Visitors include school children, college students, bird-study groups, writers, photographers, conservationists, ministers, and even hunters who, of course, are minus guns. Some stay only an hour or two, others bring picnic lunches and make a day of it. They learn more in a day of close-range observation than they could in a week of watching the birds from a distance.

Both Mr. and Mrs. Gaddy visit their pond twice daily, though it is a mile and a half from the house. As we noted, they have long since lost interest in roast goose. They look upon these wild birds as their children. They eagerly await their arrival in the fall, and in spring they remain at the pond until dusk to say "good-by" to the restless birds.

When March has passed, there is a deep quiet over the Gaddy farm. The pond is empty except for a few crippled birds and descendants of the original decoys. A kind of sadness descends. The days drag until October when the geese return. But Mr. Gaddy has something to look forward to that is more exciting than his shotgun and hip boots. He finds greater satisfaction in having won the friendship of these majestic birds of passage.

Drawing by Museum Illustrators Corps

MONSTER of the *Mist Forests*

A heavy pause, a violent snort, a sudden turn, and the massive African black rhinoceros charged through the brush, downing everything in its path. Here, indeed, was nature's counterpart of the Sherman tank

By KEN STOTT, JR.
General Curator, Zoological Gardens of San Diego

TANGLED forests clinging closely to the contours of mist-shrouded slopes; ravines of blood-red rock; filmy plumes of water plunging into foaming and tortuous stream beds — this was the stronghold of the monster of the mist forests.

While I waited still and motionless, the guttural chuckle of a colobus monkey echoed through the jungle, and intermittently the throbbing call of a touraco emanated from some hidden perch. From the distance came the sound of the breaking of brush and the muted trumpeting of an elephant. Night was enveloping the East African forest with the rapidity that is typical of the passing of equatorial dusks and dawns.

Suddenly, from up the trail, muffled footsteps advanced, sucking and sloshing in the ooze. A blustering wheeze of uncertainty rent the air. Then a heavy form detached itself from the forest and the increasing gloom.

As it stepped into the clearing, four yards of massive, wrinkled power and two menacing horns became apparent. This was the monster himself—the African black rhinoceros!

Once he had emerged from the forest, he broke into a swaggering trot and made his way to the waterhole with all the grace of a Sherman tank. He stopped on the bank and lifted his head to sniff the air cautiously. Eventually satisfied that all was as it should be, he lowered his head and began to guzzle his evening drink.

The resulting sounds were scarcely indicative of proper table manners. He slurped and gulped with all the gusto of a truck driver over a cup of steaming coffee, and when at last he had slaked his thirst, he did the truck driver one better. He wallowed in his cup!

Gingerly, he waded into the water and lowered himself into the mud,

and when half-submerged, he began to thrash with gay abandon. Legs, head, and tail were tossed in every direction as he rolled from side to side on his back.

Then after a moment he stopped, sat up on his haunches, and looked about himself in a most apologetic manner. He rose to his feet and, as daintily as before, tiptoed from the wallow to begin his nocturnal foraging.

It was now quite dark. Only the light from the moon overhead lent a shadowy detail to the landscape. The rhino, a vague black form, lumbered about the clearing, pausing now and then to nibble at the leaves of some low-growing shrub. In the darkness he resembled an animated boulder, and as such he was not particularly exciting. The time had come to take matters into my own hands.

With a flip of the thumb, I switched on a powerful flashlight, and the rhino stood motionless in a pool of light. Had I been on ground level, this action would have been nothing less than foolhardy, but here in the lofty security of Treetops Inn* I had ample reason to feel safe. Treetops, a glorified blind constructed in the branches of a giant jungle fig tree, is an ideal place for even the most timorous of sightseers to view Africa's most cantankerous game without an iota of danger.

After a moment of immobility, the rhino was galvanized into action. He squealed at the top of his lungs and, wheeling frantically, tried to escape this terrifying blaze of unknown origin. All at once he charged, first one way, then another, pausing between charges to squint at the light with his weak little piglike eyes.

Finally, when he could stand it no longer, he barreled out of the clearing as fast as his stubby legs could carry him. With no attempt to find one of the several trails that converged upon the clearing, he merely made his own as he galloped along, pushing down anything and everything that stood in his path. Long after he had disappeared from view, I could hear his panic-stricken squeals and snortings and the violent crashing of brush.

Incredible though it seemed, this mighty beast was scared stiff—the same animal that has been known to derail locomotives and overturn trucks. With my own eyes, I had only a short time before seen a rhino rout a herd of the dread African buffaloes. It was hard to believe and even harder to understand.

The answer came a day or so later from a veteran trapper, Hugh Stanton.

"The rhino's really a very mild-tempered fellow," he told me, and when I appeared skeptical he went on to explain, "He possesses notoriously bad sight. Consequently, the old boy's got to be constantly on the alert, depending almost entirely on his senses of smell and hearing. Any unfamiliar sound or scent sends him into uncontrolled panic. Frequently when he appears to be charging, he actually thinks he's running away from the danger."

"This," I remarked, "must be very comforting to anyone who happens to be in his path."

Stanton ignored my sarcasm. "Of all the animals I've collected for zoos," he continued, "I'd call the rhino by far the most responsive. I've found it possible to tame a full-grown rhino within a month of his capture. It's all a matter of mutual understanding. Treat him gently and quietly and you'll have a perfectly reliable pet."

All of Mr. Stanton's opinions may well be true (and I for one would hesitate to contradict them), but a rhino remains a formidable adversary in the bush. Rhinos are most active during the hours from dusk to dawn, at which time they are difficult to discern and thus avoid, being as dark as the night itself. During the day, they usually retire to the depths of the forest or, if they are plains-dwellers, into the densest thornbush thickets. Once they have entered the vegetation they become almost invisible. The nondescript gray of their leathery hides serves as excellent camouflage. Thus, an innocent traveler can stumble upon a rhino before detecting its presence, and in the resulting encounter it is sometimes difficult to convince the beast that one's intentions are harmless.

The black rhino is found in a variety of habitats: the lowland deserts, the upland bush and plains country, and even in the forested mountain ranges; but he is commonly looked upon as a denizen of the first two only. This may be due in part to the fact that game photographers, because of the nature of the forest habitat, have been forced to limit their activities to the other two, where the light and climate are better. But even fairly authoritative natural history texts sometimes dogmatically restrict the distribution of the black rhinoceros to the drier, open terrain of Africa south of the Sahara. Regardless of the cause, the black rhino, as far as the layman is concerned, has erroneously emerged as a creature of bush and desert only. Nonetheless, it is in reality every bit as much at home in the densest of East African mountain forests, and in some such areas it is extremely abundant. Hunters maintain that the mountain-dwelling rhinos develop longer horns than their lowland kindred, but otherwise they differ neither in appearance nor habit.

Wherever it occurs, the black rhinoceros is primarily a browser. It feeds on succulent aloes and euphorbias, as well as on the leaves of acacias and other scrubby trees. It is innately fond of wallowing, perhaps because of the hordes of insect parasites that dote upon it. Even the omnipresent tickbirds seem utterly incapable of coping with the situation. Although the rhino is a great wanderer, it is seldom found far from water; and according to native lore it possesses a remarkable memory for local geography, which guides it unerringly from one watering and wallowing place to the next.

Sociologically speaking, the black rhino is essentially a lone wolf. Only during the breeding season does one rhino customarily join forces with another. In but a single instance was I privileged to observe more than a solitary bull or a mother and calf at one time. In this case, a father rhino

* See "Treetops," by Lt. Col. and Mrs. William J. Morden, NATURAL HISTORY for May, 1949.

apparently wished to have a hand in the rearing of his offspring.

The scene was in Kenya's northern desert, near Wamba, and I watched it from the vehicle of Hugh and Jane Stanton, who were conducting me on a brief tour of the Northern Frontier District.

They made a tender sight, this rhino family. Mother, father, and half-grown baby stood testing the air suspiciously about three hundred yards away.

Stanton howled gleefully, "Now for some real sport!"

Somehow, I didn't quite like the sound of that. I had a very uncomfortable feeling that Stanton's idea of "real sport" might differ from mine.

He started the car, turned it around, and headed toward the rhinos. They stood their ground for a minute, snorted audibly, then scattered as we drove into their midst. We stopped and they stopped, one on each side of us and the third in front. Once again we began to move, and when we started, they started, this time converging upon the car. It was the beginning of a wild game of tag among the "four" of us, and it was one in which I did not care to be "it."

The three leathery, armor-plated monsters presented a thoroughly unpleasant picture as they rolled toward us from their separate directions, and the thought of the picture our vehicle might offer if they reached us was even worse. Apparently Hugh considered the same possibility, for he slammed his foot on the accelerator with a vengeance.

Off we went, with the rhinos on our tail, about a hundred feet behind us. Finally, they appeared to be thoroughly tired and stopped short in their tracks. Wheeling the car around, Stanton drove toward them again. At about eighty yards, he turned the car sharply to the right and, slamming on the brakes, switched the motor off.

"There's a picture for you!" he shouted.

I had completely forgotten about the camera in my hand and, at the moment, taking a picture was the last thing in the world I wanted to do. The rhinos, snorting and pawing the ground, were obviously on the verge of a charge.

"Let's get out of here. The heck with photography!" I yelled back.

Stanton shook his head firmly. "Not until you've taken your pictures."

I swore at Stanton, I swore at the rhinos, and I swore at the camera, but apparently I had no choice in the matter. I pointed the camera at the rhinos and without the slightest hope of getting a decent exposure (and caring not in the least) I began snapping pictures. Then all at once, the rhinos charged!

Mr. C. B. Perkins, one of my coworkers at the San Diego Zoo, has often sarcastically observed that I create the impression of existing in a perpetual state of imminent danger, regardless of where I am or what I am doing—and perhaps he is not without some justification. I wish, however, that on this occasion he might have shared in the adventure (and I vaguely remember wishing it at the time). Even now I do not like to imagine what might have happened had our engine failed or had we dropped into one of the all too numerous pig holes.

The rhinos throttled toward us like a trio of jet-propelled steamrollers, and I held my breath while Stanton ground on the starter. After a hysterical sputter, the car jerked into motion and away we went at a speed of nearly thirty miles an hour. The rhinos followed close behind, with their wicked horns aimed at

▼ THE MENACING HORNS of the black rhino are more dependable than its eyes. Notoriously bad sight keeps the animal on the alert, and any unfamiliar sound or scent will send it into uncontrolled panic

▲ WALLOWING in the mud is great sport for the rhino—and possibly great necessity. The hordes of insect parasites that dote on the beast seem unable to cope with this activity

our rear bumper. We veered to the right to miss a boulder and swerved to the left to avoid a thicket, all the while heading for the road. The rhinos meanwhile had begun to slow down and, just as we reached the road, they lost interest in the chase and dove into a thicket.

As we resumed a normal speed, the color (or lack of it) on Stanton's face gave me a certain degree of comfort. Mrs. Stanton, who had remained tensely silent throughout the entire episode, now patted her brow delicately with a handkerchief and said, "Wheeeu! There was a moment there when I thought about pig holes." A moment! I concluded that any remarks I might make would be better left unsaid.

There is no more dutiful a parent than a mother rhino. She sometimes keeps her baby with her for several years—long after it is quite capable of fending for itself. Only a very young rhino is in danger of being preyed upon by other beasts and then only by lions. But the mother rhino looks upon her child as a precious but completely helpless infant, even when it is almost as large as she. Any cause for alarm, and she moves in front of the baby, daring the intruder to come one step nearer her beloved charge.

Other than man, the black rhino has few enemies. However, one notable exception, or so legend has it, is the elephant. Professional big game hunters insist that the two are deadly foes and that the elephant invariably emerges victorious from any conflict between them. A rhino, it is said, will never remain in the presence of an elephant. This seems open to question since on several occasions I have watched specimens of both species drinking from the same small water hole without the slightest indication of incompatibility.

The reactions of a rhino to other forms of animal life is entirely unpredictable. Sometimes it may drink or forage amidst a group consisting of several different species of animals and yet appear oblivious to their proximity. On other occasions it obviously wants the area all to itself and makes no bones about the matter. Whether this contradiction in attitudes is due to individual variation in disposition or merely the momentary state of the mind of the beast, I do not know.

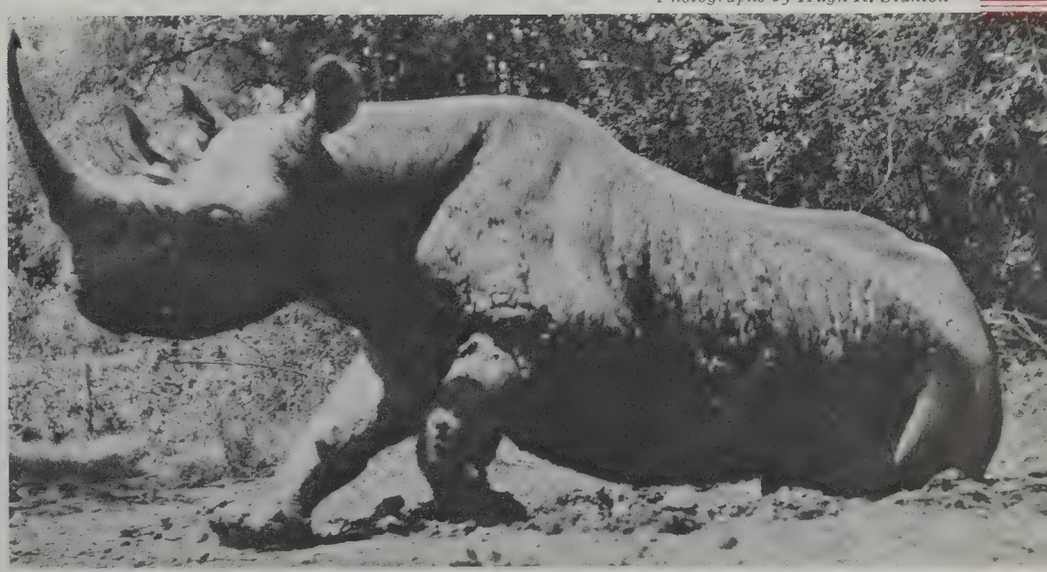
One evening I watched a rhino charge directly toward a herd of buffalo, scattering them in all directions; and in another instance, a female rhino and calf sent a group of ten giant forest hogs scrambling away from a water hole. The rhinos were not content to drink until the forest hogs had entirely abandoned the clearing in which the muddy pool was located.

Numerically, the African black rhinoceros occupies a regrettably precarious position, and it has disappeared altogether from regions in which it was once common. That its numbers have dwindled so rapidly is due in part to the ravages of trophy hunters, in part to the inevitable encroachments of civilization, as well as to systematic slaughter of game of all types in the current and perhaps misdirected campaign to control sleeping sickness.

It is not inconceivable that the day will arrive when the black rhino has been entirely eradicated in the more open and accessible parts of its range, surviving only in the tangled mountain forests, which now constitute but a small part of its native haunts. Barring the removal of the jungles themselves, the black rhino may survive there almost indefinitely—a relic of the distant past, an awesome and incredible monster of the mist forests.

▼ THE BLACK RHINO is essentially a lone wolf, and only during the breeding season is it customary for one rhino to join forces with another

Photographs by Hugh R. Stanton



▲ TIMBERLINE LODGE below Mt. Hood peers above the snow only with difficulty. In February, with 200 inches of snow, Mt. Hood is a wonderland for skiers, and their sport continues into July

◀ ONE MARVELS at the patience required to carve such an intricate figure if it can last only as long as winter reigns. But the credit really goes to the sculptor who fashioned the monument underneath, not to the man who sprayed it with water to bring the covered wagon into harmony with the season at Sun Valley

WINTER *through the Camera's Eye*

What artist dares to rival
Winter's creative genius?

By JOSEF MUENCH

▼ A FAIRYLAND greets the Snake River as it makes its pilgrimage through Jackson Hole in Wyoming. Every tree is ornamented with ice and snow, against the tranquil background of the crystal peaks

▲ EVERY TREE, with its burden of snow, becomes a fantastic creature, and the imagination peoples the forest with all manner of weird beings. South slope of Mt. Hood, Oregon

▲ A SKIER'S VIEW of Jackson, Wyoming, with the Grand Tetons rising in splendid array against the sky line

▼ YOUNG NAVAJOS, regardless of weather, ride their ponies over th lunar landscape of Monument Valley to herd the few horses they ow

▼ ELK, coming down to a feeding station in Lamar Valley in Yellowstone Park. Like all of our National Parks, this is an animal preserve

▲ THE GRAND TETONS, lifting their snow-laden forms above the smooth valley of Jackson Hole. Grand Teton (*center*) is 13,766 feet above sea level, and its neighbors lift high enough to share its glory

▲ THE "KONO" moored in a cove near camp. Before the accident, she brought all supplies from Port Moresby and Daru and dropped stores for nearly four-score men in the expedition's camps in the mountains. Her capsizing at Port Moresby occasioned the rafting adventure

➤ THREE RAFTS NEARLY FINISHED for the journey to civilization. Rand, in the foreground, directs the stowing of his collection of birds. The built-in fireplace is in the immediate foreground. The author's raft is already equipped with its tent. In the middle is one of the "boys'" rafts

Raftin

The story of a party of white men and their native Papuan helpers who journeyed on rafts hundreds of miles down a swift and almost unknown river in New Guinea

By G. H. H. TATE

Curator, Department of Mammals
American Museum of Natural History

All photographs by Archbold Expeditions

THE 1936-1937 Archbold biological expedition of the American Museum of Natural History had been in New Guinea but a few months, and 5 of its members with 75 Papuan natives were in the final stages of an attempt to reach the very heart of the great central highlands at the head of the Fly River—when the accident happened. The amphibian plane that had carried us into the interior hundreds of miles from our base at Daru, and afterward acted as aerial ferry and supply ship, capsized at her moorings in Port Moresby harbor. Word of the disaster reached us by radio, together with assurances that a rescue launch would be sent upriver as soon as obtainable.

Our upriver party comprised the ornithologist A. L. Rand, in charge; L. J. Brass, botanist; Michael Healy, police officer; Alan Willis, in charge of native labor; and the writer, who besides collecting mammals and invertebrates operated the radio set. A few weeks earlier we had divided into an advance party cutting track up the forested, rain-soaked mountains and a collecting party stationed at the foot of the mountains. At the time of the crisis Willis, Healy, and I, with most of the "boys," were in the advance group almost a week's walk beyond the camp where Brass and Rand with their helpers were at work.

The prospect was alarming chiefly because our mountain party had food for only nine days, and the weather was so stormy we could not be sure whether extra supplies could be flown in to us. Flying in those poorly mapped mountains in such weather was extremely dangerous. However, a chartered plane flew over a few days later and through an opening in the clouds spotted one of our camps and dropped additional food. Meanwhile the group at the foot of the mountains had picked up the bad news. It was then reluctantly decided that as there was no longer any way to supply the advance group the upland work must be abandoned. We had but one way to leave: the mountain group must walk back to the lowlands camp, and rafts must be built there so that the entire party could float down the river.

I took a gang of boys and the radio set and moved out first, followed a few days later by Willis and Healy with the rest of the hired natives. It was a nightmare trek amid almost

...wn the Fly River

constant rain over the most rugged, densely forested terrain imaginable. Suffice to say that we got there and found Rand and Brass with every available man already felling trees with which to build rafts.

The main camp in the lowlands stood in a tiny clearing amid tall forest, at the edge of the Palmer River, a principal tributary of the big Fly River. The Palmer was a stream 70 yards across, unpredictable and full of vagaries, rising and falling a score of feet with the changes of the weather in the mountainous hinterland. The wild native bushmen had come to tolerate our presence to the extent that the lives of our "boys" were reasonably safe provided they went about in pairs, one of them carrying a gun. But to ensure perfect safety at that time of the emergency, the boys were sent into the forest to cut great logs for raft building in groups of half a dozen, with an armed policeman in charge. Meanwhile our precious collections of zoological and herbarium specimens, comprising hundreds of preserved birds, animals, insects, and plants, were packed, and a beginning was made of dismantling the camp.

For days the forest echoed to the sounds of chopping and the periodic crash of falling trees. At intervals a boy came riding downstream astride one of the huge logs, guiding it with astonishing skill by means of a paddle improvised out of a stick. Each tree trunk arrived equipped with a "bush rope"—fashioned out of the climbing palm known as *Calamus,* the rattan of commerce—tied tightly to it to act as a mooring rope.

The logs were assembled at the mouth of a small stagnant creek near camp, which had been selected as

▼ THE "A-WIN" TRIBE of the Palmer River, coming to trade natural history specimens for beads and pigments with which to adorn themselves. It was one of these natives who stood in the deserted camp beating on a kerosene can when the raft flotilla drifted past. The palm covering over the tent is a sunshade

▲ AN EARLY STAGE IN RAFT MAKING. The boys rode the logs down the river and assembled them in spots sheltered from the current. Healy facing the camera, Rand at the oars in the folding dinghy

▲ LASHING THE FLOAT LOGS together with heavy crossbars. The bush rope used was a climbing palm, *Calamus,* locally called *wairo* and known to Australians as "lawyer cane"

the spot best suited for construction of the rafts. Several boys were detailed to collect quantities of "wairo" (*Calamus*), with which to lash the yard-thick logs together. Building operations started. The tree trunks were lined up parallel in groups of four and were held there by means of poles thrust deep into the river mud, while band after band of tough-fibered bush rope was looped around them and pulled up taut. Strong cross poles were bound solidly into place above the float logs, and on top of them again was tied a floor made of split sago palm trunks, the whole built up to give the deck surface a clearance of about one foot above the water. Not a nail or any other piece of metal went into the construction. The biggest raft was estimated to weigh close to six tons. When completed, it measured 11 feet wide and some 25 feet long. The smaller rafts attained only about three quarters of the dimensions of the largest; their cargo-carrying capacity was, of course, very much less.

Each night a police guard was stationed to watch the precious shipyard lest some mischievous bushman cut our hard-won navy adrift.

In something more than a week, the work was done. Twelve sturdy craft, moored fore and aft, lined the water's edge. At the rear of each was a quantity of firewood and a built-in fireplace for cooking made of a large shallow box filled with sand. Each raft was also equipped with a steering oar and half a dozen paddles. The order was given to embark.

When an unknown river must be traversed for an undetermined number of days, it is well to take every precaution and lay plans with the utmost care. Our party hoped to be able to keep together so that if any raft got into difficulties, others might come to its assistance. Each day we would start out as soon as possible

◀ AFTER the main lashings and crossba
completed, a second series of poles laid
wise formed the foundation of the
poles or split palm stems. The deck s
most about one foot above the wate

after daybreak and travel until an hour before dark. A small collapsible dinghy served to keep up communications.

Five of the craft were captained by white men, the other seven by the native police sergeant, the cook, and selected boys. The crews were carefully chosen and assigned. Supplies of food and equipment were stored near the center of each raft and covered with tarpaulin so that the heavy splash of water from rapids or whirlpools would be less likely to reach them.

Each white man arranged his raft and equipment to suit his tastes. Each also assumed responsibility for his own collections. As I had charge of the radio set and power supply, with a small stock of gasoline for the motor, I was assigned the biggest raft. Each man had a sleeping tent small enough to be erected on the forward deck. This, with a strip of canvas shading the deck just in front of the tent, made a combined sleeping place and piazza from which, seated in his folding canvas chair, the skipper could survey the whole river. The cook, the crew, and the man at the steering oar lived at the rear. So much for our preparations.

During the last few days, the forest people, the "A-win," had been gathering. They divined what was about to happen, and they began to assemble so as to be first into the deserted camp to gather abandoned treasures such as empty cans, sacks, boxes, and gasoline tins.

One by one the rafts pushed off into the deep, swirling current, for the Palmer River was once more rising as a new flood descended from the cloud-hung mountains. The crew of each raft paddled hard for midstream so as to avoid being carried into the low entangling branches that overhung the banks.

As we swept past the camp we had occupied for months, we saw a bushman standing there, his filthy hair plaited with straw, his nearly naked body daubed with yellow paint—obtained from us in trade for animal skins. He shouted unintelligibly and beat violently with a club upon an old kerosene tin. A few seconds later a bend of the river cut him off from our view. Bad weather had been threatening. It began to rain.

Every man concentrated tensely upon the behavior of his raft and its navigation. The helmsman found that he could hold the head of the craft downstream with comparative ease. But we found it very difficult to move nearer or farther from the bank. A decision had to be taken, as we approached each turn in the river, whether to guide the raft to left or right. So ponderous a mass of logs surging along on a seven-mile-an-hour current required hard paddling on the straight stretches in order to have it in position for the next curve. In places, rocky headlands pushed out into the stream, setting up back-eddies whose effects upon the rafts varied from mere annoyances to really dangerous whirls.

Sometimes the river widened enormously. At such places huge, slow-moving eddies existed, whirls a hundred yards across and perhaps three times as far up and downstream. They helped us work in from midstream to the bank when it was time to tie up for the night. But they also held us tenaciously when we wished to leave in the morning. My large raft was so unwieldy, its inertia so tremendous, that despite violent efforts, the paddlers managed to drive it out of one of these eddies only after two tries—and each complete circuit of the backwater required just twenty minutes to complete.

When a rapidly flowing river rounds a curve, the current moves slowest close to the inside, fastest at the extreme outside. The approach must be made about halfway between the inside bank and midstream. If a raft came too near the inner bank, it was likely to be drawn into an eddy. But it was far worse to approach on the outside. The velocity of both water and raft increased alarmingly, and the vast momentum generated by the tremendous weight of the timbers tended to drive the craft tangentially outward, perhaps to strike against rocks and break apart.

Such an experience almost befell one of the convoy. The crews of the rest watched in utter helplessness as, wholly beyond control, one raft

AS THE RAFTS WERE COMPLETED, the "ship-d" became a veritable tangle of discarded h rope. On several of the rafts small tents e erected. One raft, finished before the ers, is partly loaded with supplies

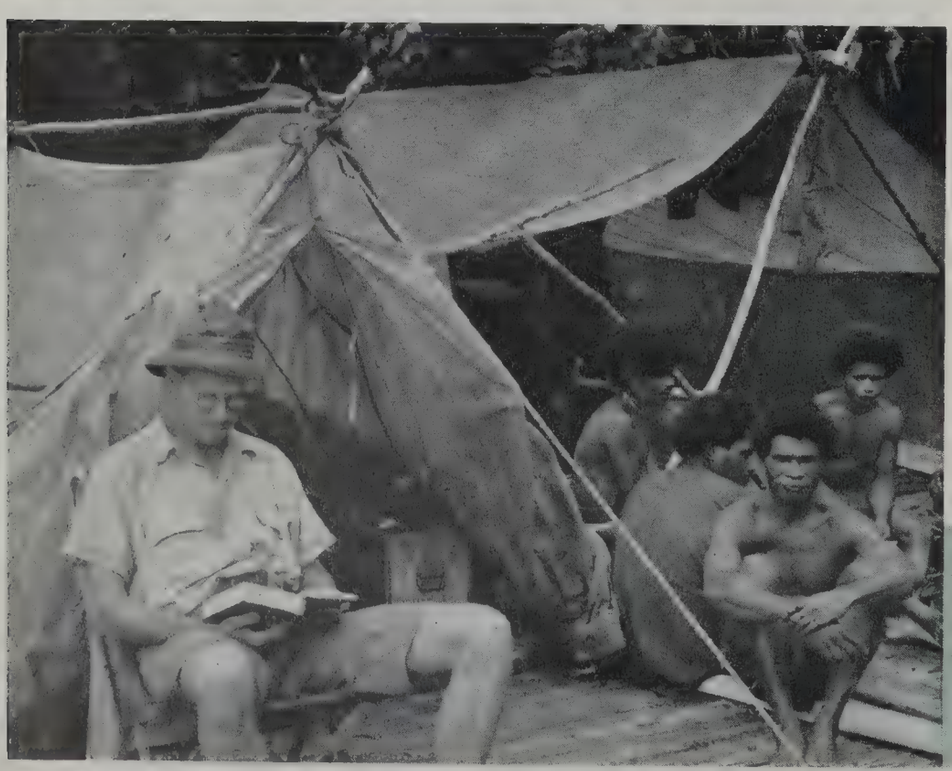
load of natives drove down the outside of the bend. The water seemed distinctly to pile up against the projecting cliff face. A huge, half-dead tree leaned low over the river, the tangled branches of its crown directly in the path of the ongoing raft. The next instant they struck it. Two of the men jumped overboard. The raft tilted sickeningly, and a great snag of wood plowed a six-foot gash through the tarpaulin. Then it swung clear. Fortunately, the river straightened out from that point, and the two swimmers climbed on board again. A few hundred feet below, when they tied up to the bank in a patch of slack water to check up the damage, they found that by something approaching a miracle nothing but the torn cover had suffered injury.

Another raft met with a minor accident by getting into water too shallow for its draft. The river had shallowed rather abruptly, and the swift current thrust the rectangle of logs relentlessly upon a bank of grating gravel, much to the detriment of the lashings that passed under the logs. Quite half the bush ropes were cut through, and most of the others badly frayed. The risk that the raft might go to pieces appeared so great that we decided to put into a quiet cove at once, cut new lashings, and make repairs. The lead raft was tied up at a suitable place on the inside of a wide sweeping bend where the current ran less violently. The crew grappled with overhanging vines. Chopping violently with their cutlasses, they carved an entry and withdrew their tent-covered craft almost from view. Raft after raft followed the lead of the first one, each coming to rest a few yards downstream from the one that had preceded it, until all twelve were snugly moored in a compact row, reasonably safe from disturbances by floating driftwood.

Half a dozen boys, under the police sergeant with his rifle, were dispatched to cut a supply of bush rope for reinforcing the lashings of the raft that had scraped the shingle bar and for stiffening the construction of any others requiring it. Meanwhile, gangways were quickly extended from the rafts to the low bank as well as from one raft to the next. Cooks carried their pots and supplies ashore, glad to move freely after many hours of cramped quarters on board. As darkness grew in the forest, campfires gleamed here and there, picking out the great boles of near-by trees, the sheen of the boys' limbs, their great golliwog-like mops of hair, and the red of their ramis—the apronlike garments they wore instead of trousers. Such evenings are pleasant to look back on. While waiting for supper to be made ready, we five whites gathered together, cup in hand, taking the evening rum and water to wash down the quotidian quinine capsule. Events of the day were discussed. Cigarettes and a pipe glowed in competition with the erratic flashes emitted by cruising fireflies. A dull red glow in the sky, reproduced in the mirror-like river, alone served to recall the sunset. After supper, "notes" were written, and every man climbed under his mosquito net.

One day the party had started under perfect conditions, the weather fair, no cloud upon the horizon. But soon things changed. Rain had been falling heavily in the mountains, and presently its effects reached our raft convoy. For the rest of the day water fell in torrents, the surface of the river jumping and boiling under the ceaseless pelting of the downpour. Visibility was often less than 100 yards. Perhaps that accounted for the very poor place at which the rafts were tied up for the night; for when the rain slackened a trifle just at sunset and we could see where we were, we found ourselves lined along the outside instead of the inside of a bend and, as later investigation brought out, tied not to the true riverbank but to a low island, whose surface then stood only a few feet above our decks. As darkness fell the river began to rise again. A big flood was coming.

That night was an anxious one. The water rose steadily; the current grew stronger. Many additional *Calamus* mooring lines were set out from each raft. My own heavy craft hung swaying and trembling at the ends of no less than eleven such lines. And on every raft, boys were stationed with flashlights and long bamboo poles, ready to fend off the



◄ RELAXATION after the worst of the rapids had been passed: two rafts tied up securely on one of those few nights when the rains held off

➤ THE RESCUE SHIP. The "Ronald S." may not be "a thing of beauty," but she appeared a wondrous vessel to the explorers when she chugged up the river to their last raft stop. She was a little crowded at times

drifting logs which the torrent thrust perilously close. The water continued to creep up inch by inch, while the raft crews chopped a way in among the sapling vegetation, in order to save us as much as they could from the direct pull of the current.

Presently the island was covered. An hour later the rafts, which drew from two to three feet, floated in over the top of the bank and were additionally secured by heavy stakes driven down all around them into the mud. Still the water level rose.

It must have been nearly midnight when a hail from the first raft warned us all of trouble. Only a few yards away a huge tree, torn from the bank far up the river, was driving past, roots foremost, as majestically as a ship. Just as it drew abreast its roots locked with some obstruction under water, and it hung, teetering for an instant while the river tore and raged through its branches. Just in time our boys, thrusting in unison with poles, stopped the inward swing which, had it completed itself, might have torn several rafts to pieces. The head of the tree was deflected outward toward mid-river. An instant later that danger had vanished in the darkness.

But the greatest trial of all came just after dawn. The men were resting, worn out by the night's vigil, the cooks were making shift to brew some coffee, and it seemed that the peak of the flood had passed.

Some of the crew of the last raft in line glimpsed what was coming and yelled to those up ahead to "look out." But it was too late. A tremendous, relentless crashing of saplings announced the approach of two gigantic interlocked trees that pivoted against each other with a kind of scissors movement. Crashing through the low screen of the island vegetation, they struck the leading raft and drove it with a terrible blow against the one behind it, and that in turn against the third. So violent was the shock that almost every mooring line in the row of rafts was snapped and the component logs of all the lead rafts were driven askew. A twist of the current drew the hinged tree trunks back to deep water, carrying our first raft pinched between them.

The crew of the front raft had barely had time to see what was swooping down upon them. All except two boys and Willis, who was captain, jumped over into the water. Those three were carried away down the river between the locked tree trunks. Their tent was torn down; they had no paddles and only a couple of poles to maneuver with. They quickly passed around a bend of the river out of sight. Two boys were at once sent after them in the dinghy with food, water, ropes, and paddles.

That incident marked the end of the struggle. The water began to recede. Every half hour its depth was probed. The current was still very strong, but we had to ease out into it a little so as to avoid having our heavy rafts come to rest on the top of the island, like Noah's Ark upon Mt. Ararat. It was almost sunset, however, before the island actually emerged. Sleep was never so welcome as that night.

In the morning the journey was resumed. Half an hour downstream the dinghy came alongside, the boy at the oars bringing a note from Willis saying that all was well. The raft had been freed from the big logs very quickly; they had repaired the lashing and repitched their tent; they were only a little way ahead.

Presently the already large Fly River converged with a tributary, also of great width. The current slowed to two miles per hour. A strong sea breeze rose in the afternoons, driving short, choppy waves up the long, straight reaches and sometimes dashing spray all over us. There was now depth of water enough for the rescuing schooner to travel without great risk of running aground. We tied up our convoy for good at an abandoned prospecting camp, the farthest upstream, to await the river boat.

Months later, as I stood on the bank far down the river, I saw one of our rafts again. It had broken adrift and was heading for the sea.

Curiosity

Caught a Booby

A method developed by early man has proved of value to starving men on life rafts

By Lewis Wayne Walker

Photographs by the author

DURING the Pacific war, the raft holding Eddie Rickenbacker and his two companions had floated for six days somewhere on the world's largest ocean. The men had had no food or water from the start. Their outlook for rescue seemed almost hopeless. And then on the seventh day, in a miraculous way, a bird circling the raft alighted on Rickenbacker's hat and furnished nourishment that kept them going for a few more days, enabling survival until search planes finally ended their floating ordeal.

Many other pilots can thank such chance captures for their survival, and yet the few pelagic birds that voluntarily landed on shoulder or outstretched hand were only the most unwary of the ocean flyers—probably young of the year, whose

▲ A Red-footed Booby approaches the white rag

innate curiosity overcame their developing fear of man.

About 65 generations ago the Polynesian peoples migrated to the lonely, uncharted islands of the mid-Pacific in simple canoes with limited space for the storage of foods—vessels so frail that we might now hesitate to use them on our placid inland waterways. Their initial exploratory trips were based on wishful thinking—the hope that an island existed beyond the horizon. Weeks and months passed far from the sight of land, and the venturesome occupants were forced to subsist on the birds and fishes that they were capable of catching en route. However, in previous centuries of island hopping, first close to the Asiatic mainland and finally eastward to Hawaii, they had learned that many of the pelagic birds were extremely curious, drawn as though by a magnet to a fluttering rag in the breeze. This knowledge was passed orally from generation to generation and eliminated much of the element of chance in the capture of feathered foods on the high seas.

Throughout the centuries that elapsed since the inception of this simple Polynesian system of luring, some of the nesting islands have been invaded by man, and the birds have naturally lost some of their fearlessness. Generally speaking, the brazen, foolhardy birds have been eliminated and only the sagacious have survived to propagate their kind. This change was noticeably accelerated in the relatively few short years of the war. When the military forces first arrived at Midway, man-of-war birds, boobies, and terns would sit on their nests until pushed from their eggs. However, after two or three years of military occupation, this trusting nature was undermined, so that practically all of the nesters would temporarily desert when a human approached within a six-foot radius. But—and this was important to castaway pilots—the curiosity of the birds remained unimpaired.

During my tour in the Marine Corps, I was assigned to the Survival Training camp, and it was my duty among other things to test the practical utility of the theories

THE WING of the captured booby with the string in place

WEIGHTED STRING starts to wrap around its wing

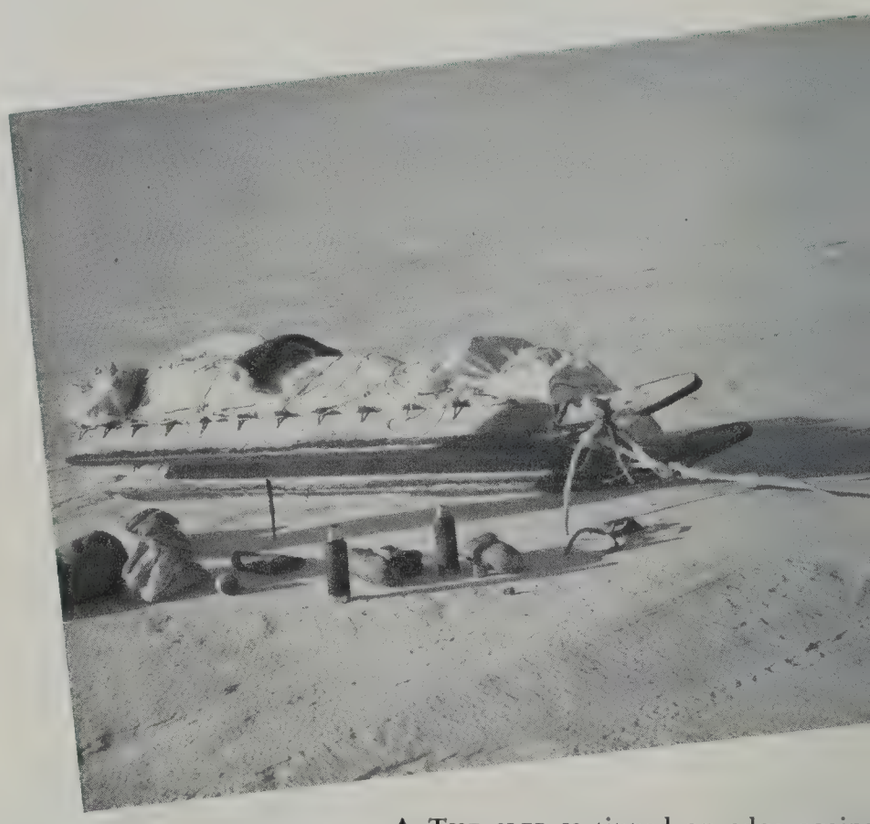
THE BIRD is pulled to the ground

being taught to the pilots. The ancient history of the Pacific was literally picked to pieces in the effort to find and test any forgotten arts that might hold better promise of life for castaway or life raft occupant. If found impractical they were discarded, but if feasible they were added to the curriculum of the survival school. Thus bird-catching became one of my jobs.

Moko Manu Island, a few miles off the coast of Oahu, was chosen for the initial tests. Incubating birds of several species dotted the ground, but they moved off and took flight whenever they were closely approached. They would have been difficult to procure without slingshot or club. Then we tried the legendary system of the ancient Polynesians and tied a white rag on the end of a branch. When we allowed it to flutter in the breeze, boobies stopped their aimless circling and zoomed toward the waving material. With beating wings they slowed and hovered momentarily on its lee side, seemingly so entranced by the motion that they were oblivious to the human a few feet below. I started a pendulum motion with a string weighted on one end, and when the bird above was in the right position I swung the weight in the air, up and over the hovering form. The instant the string touched the outspread wing, the weight caused it to wind around, making the bird my captive. Primitive peoples in various parts of the world have used these so-called bolas for catching birds or other creatures, and many will recall having heard of them among the Gauchos of Patagonia.

On those first tryouts we made eight catches in eleven attempts, and this average was almost upheld when later experiments were made from a floating life raft. All of the birds were liberated after being unwrapped, but several of them swung around in a great circle to the decoy again—sure evidence that the birds called boobies are not misnamed.

ESKIMOS Gla



▲ THE SLED IS tipped on edge agains
block of snow to expose the runner w
out unloading everything

...eir Sled Runners

Lubricating oil would have little use in their wheelless life, but they have devised an ingenious method of overcoming friction

By THE REV. CANON J. H. WEBSTER
St. Andrew's Mission, Coppermine, N.W.T.

Photographs by the author

ESPECIALLY when the temperature falls far below zero, the dog sled plows through the dry snow as though it were going through sand, and the effort of pulling it is doubled or tripled. The Eskimo then needs a coating of ice on his runners. Ice will not stick well to wooden or bone runners, so a backing of frozen mud must first be applied. This is made by mixing earth, moss, or other material with water and applying it as a paste. Sometimes today, rolled oats or other porridge is used. The frozen mud is then smoothed with a woodworker's file or an old plane, and a coating of water is applied. Sometimes the water is warmed in the mouth and squirted on; sometimes it is heated in a pot and poured onto the bearskin mit that is used to smooth it quickly before it freezes.

On rough ground the ice shoeing often breaks off, and repairs have to be made on the trail. The Eskimo carries a little bag of water just for this purpose. This whole procedure --an arduous one under sub-zero conditions--is not merely a fad among a few sled travelers. It is a familiar routine to most of the Eskimos from Alaska to Greenland.

CARE IS USED in shaping the backing of mud. ...e the smooth surface that is formed before application of water

▲ WHILE THE ICE was being applied with the fur "smoother," the runners were shaded from the April sun by a propped-up skin in this instance

➤ THE ONE WHO BENEFITS: a sled dog happy for the rest and grateful for a new pair of frictionless runners

MONTEZUMA'S Pink Castle

The vast lands of the Southwest were theirs for the taking, but enemies forced hundreds of early Americans into a five-story apartment house—an architectural achievement but a prehistoric slum

By NELL MURBARGER

WITHIN 150 miles of that famous corner common to four states may be found virtually every known cliff dwelling in America's Southwest. One notable exception is Montezuma's pink castle. Situated more than 200 miles from the above-mentioned point and almost directly in the center of Arizona, the Castle is far more widely known than most other cliff dwellings. It is easier to get to, and the public has long been conscious of it.

Passage of time has done nothing to diminish its appeal. During the travel year ending on September 30, 1948, more than 26,000 persons were stirred by the sight of this five-story apartment house, built half a millennium before Columbus set sail for the so-called New World.

No one seems to know who was responsible for giving this edifice its name. Certainly he was a romanticist. Not even a high-salaried Hollywood press agent could have devised a name with more public appeal. Montezuma's Castle! Montezuma, the picturesque and fabulously wealthy king of the Aztecs . . . and coupled with this, the word Castle—a holdover from fairy-tale days, a place of turrets and moats, of dark deeds and clanking swords and knights in shining armor. Surely the components of romance unfettered.

Climbing down into the levels of reality, however, we find that this building never was a "castle" in the sense of being occupied by one potentate and his court. Rather it was a prehistoric apartment house, tenanted by many families. As for Montezuma, there is no record that this Aztec leader ever set eyes on what is now Arizona. Most certainly he never dwelt in this cliffside aerie, because the place was built, occupied for a dozen generations or so, and abandoned to the winds all before Montezuma's birth in 1476.

Fortunately, the known story of Montezuma's Castle is no less romantic than the fanciful connotation of its name. In the first place, there is probably no more pleasant spot in all Arizona than the colorful Verde Valley in which it is located. Fed by numerous mountain tributaries, the tree-bordered Verde runs deep and clear and cold through a smiling meadowland. Here grass grows tall and green, and wild flowers bloom. Flanking the fertile valley are high, perpendicular cliffs of white limestone, brilliant red sandstone, and outpourings of dark lava. Stretching back from the rim of these cliffs are the high, wild plateaus of north-central Arizona; and still farther distant lie snowy blue ranges, densely forested with pines and fir and teeming with fish and wild game.

Southerners from the lands of the Salt River and the Gila moved into this attractive valley. As nearly as students of archaeology have been able to determine, this migration took place during the eighth century. While this was an age that saw nearly all the world's "civilized" men engaged in warfare of one sort or another, even then these Hohokam were a thrifty, industrious people—peaceful, well-fed agriculturists who knew the proper time to plant corn, squash, beans, and cotton, and how to lay the grade of irrigation canals so that the life-giving water of the river might be carried to the valley's farthest fields. Here they apparently knew freedom from persecution for 200-odd years.

In addition to their agricultural activities, these people made relatively good pottery vessels of two types—plain gray, and buff with red designs. They lived in one-room dwellings fashioned of poles overlaid with brush and reeds and plastered with mud, thus affording wind resistance and a measure of security from rain and snow. They were a distinctly rural people, having no cities or large centers of population. They lived a single family to a dwelling.

About the beginning of the eleventh century, trouble appeared on the scene in the form of nomadic hunting Indians—men most familiar with hunger and privation. Suddenly, the well-filled granaries and storehouses of the Verde—hitherto a source of both individual and tribal pride—became only centers for looting, and their defenders, candidates for death.

While methods of warfare, of offense and defense, have changed with succeeding generations, the principles have remained unaltered. Since the siege of Tyre, beleaguered men have sought strength in numbers. On the Verde this meant gradual abandonment of the single-family dwellings and ultimate construction of great communal tenements. By virtue of their location, on hilltops or in natural caves in the cliffsides, such pueblos were far more defensible than had been the individual homes.

It must have been with great elation that a group of the harassed farmers first realized the building

Nell Murbarger photo

▲ Built about 9 centuries ago, Montezuma's Castle was occupied as a fortress-home for possibly 300 years. Unsanitary living conditions may have contributed to its decline. The Aztec leader for whom it was named probably never knew of its existence.

possibilities offered by a great cavern-pitted limestone cliff that lay along the north bank of Beaver Creek. Here, beside this sparkling little stream, was farming land equal in every respect to that flanking the Verde, four miles distant. Here flourished wild berries, nuts, herbs, and medicinal plants. Here were wild animals for the hunting and trees ample for building purposes; and, most important of all, here was a sheer 150-foot-high cliff indented by great crescent-shaped pockets in which 100 men and their families might know safety and security. Thus was begun one of the Southwest's most magnificent building projects of prehistoric times.

Before that limestone haven on Beaver Creek could be made useful to man, it was necessary that a usable trail be forged up the cliffside. In some places this was done by gouging hand and toe holds in the solid rock. Other sections of the tortuous climb were spanned by ladders, consisting of crosspieces bound to poles by means of skin thongs.

When tribal workmen set about felling the great white-barked sycamore trees for ceiling beams and floor joists, it was necessary that they accomplish that gigantic undertaking by means of crude stone axes. They lopped off the branches and cut each timber to proper length to fit some individual requirement. Then followed the tremendous task of transporting these cumbersome, unwieldy beams up that sheer rock wall to the chosen niche.

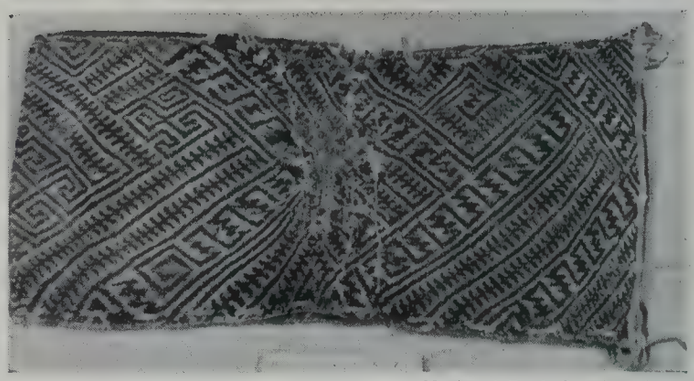
One by one the log timbers went up the cliffside, there to be fitted into notches laboriously hacked from the solid rock of the cliff's rear wall. Meanwhile, over the same trail, borne on human backs, were carried adobe plaster and mortar.

We know that when the project was completed, three distinct apartment houses had been erected within a half-mile section of cliff wall. Largest of these was a tenement six stories high, containing forty-five rooms. One hundred yards farther east rose a second communal dwelling of five stories and twenty rooms.

The six-story apartment was destroyed by fire and abandoned a hundred years or so later. The second in size—Montezuma's Castle—still stands, 90 per cent intact after 900 years. Its remarkable state of preservation is attributed to the great shelving overhang of rock which has served to protect it from the elements. It was lived in for 300 years. In the United States today, there are few buildings of white man's make that have been used for so long a period, even among the venerable Spanish missions of New Mexico.

During those three centuries the inhabitants of Montezuma's Castle lived through the Great Classic Period of pueblo culture. Although they never progressed into the use of metal, their stone tools and implements showed constant improvement of line and craftsmanship. Also, they made baskets of pleasing appearance and sturdy construction. They wove durable sandals and bags of yucca fiber. They made pottery

▲ THE PEOPLE of Montezuma's Castle made pottery in brown and red and gray types. These polychrome bowls were found in graves



National Park Service photos

▲ AN ANCIENT COTTON BAG from Montezuma's Castle, twelve inches long and woven by the "weft-floating" technique

in brown and red and gray types and traded with the Hopis and Indians of the Flagstaff area for white pottery artistically decorated in black. They made exquisite jewelry of turquoise mosaic and of seashells traded from the Pacific coast or Gulf of Mexico.

Perhaps the greatest of their accomplishments, however, was the highly-skilled manner in which they manufactured cotton cloth. We are often inclined to regard cotton as a relatively recent innovation, yet long before white man ever set foot within the province of Arizona and New Mexico—even as much as 1200 years ago—Indians of that region were cultivating extensive fields of short-staple cotton.

From their irrigated farms along Beaver Creek, the people of Montezuma's Castle and adjacent pueblos gathered their fluffy white harvest, ginned the bolls by primitive means, and spun the linters into yarn and sewing thread. This, in turn, was woven into cloth—some of it elaborately patterned.

Archaeologists, excavating Montezuma's Castle in 1923, uncovered a baby burial made more than five centuries before. The infant had been interred in his little blanket of hand-woven cloth, which still showed plainly the exquisite workmanship and the infinite care and patience of some loving woman.

A Glimpse at Yesterday

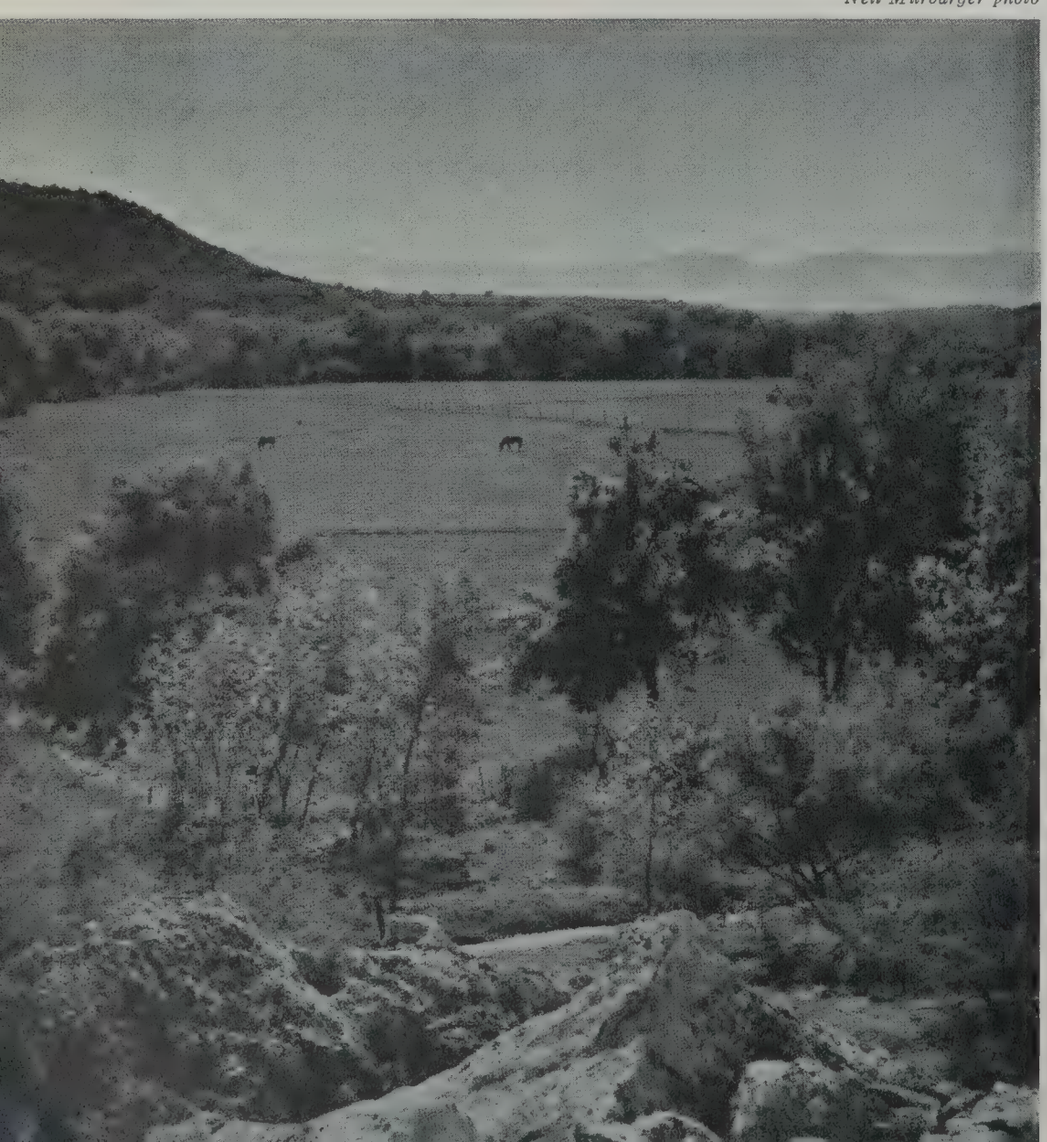
The opportunity to visit this wonderful place came to me last year in October. Equipping ourselves with a booklet, we set out on a journey of discovery. Interesting shrubs, trees, and archaeological features en route had been marked with numbered stakes, corresponding to numbers in the guidebook which served to interpret and explain.

Stake No. 7 brought us to an amazed halt.

"Behind this stake," explained the guidebook, "is a large ground floor room. It is one of over 40 rooms which once made up this great six-story cliff dwelling. The building was destroyed by fire several hundred years ago . . ."

We hadn't previously realized that any tangible evidence remained of that grand structure which originally had contained twice as many rooms as the immense pink castle

Nell Murbarger photo



◀ THE RICH BOTTOMLANDS of Beaver Creek and the Verde River were tilled by the prehistoric farmers who inhabited Montezuma's Castle

Nell Murbarger photo

▲ NINETY PER CENT INTACT after about 900 years, Montezuma's Castle stands as one of the Southwest's most magnificent building projects of prehistoric times

100 yards to the east. On the floor of the room, presumably as some Indian family had left them, lay a couple of primitive milling stones—a trough-shaped metate and a small mano.

Another few steps along the cliff's base took us to a cave designated by park authorities as the Charnel House, and a short distance beyond lay the cemetery.

Nothing about this primitive burying place is remotely suggestive of a modern mausoleum; yet, strangely speaking, that was its function. The limestone ledge, crossed by the trail, originally extended out to form a roof over seven graves, all of which were carefully sealed by slabs of limestone. Excavation of the seven graves produced parts of fifteen skeletons. The accepted theory is that the cliff dwellers became crowded for cemetery space and were forced to shovel out old graves to make room for brethren more recently departed. Evidently not too

National Park Service photo

▲ MONTEZUMA WELL, a natural spring. Several well-preserved cliff dwellings can be seen in the upper portion of the wall encircling the "well"

much care was given to removing the complete skeleton.

Continuing along the fascinating, sycamore-shaded foottrail, we soon found ourselves back at the point of beginning, where a ranger informed us that the first nine persons who arrived would be accommodated on the first tour.

The ladders by which one reached the castle proved to be thoroughly well made and sturdy. We had wondered how visitors could be restrained from entering the ruin unescorted. The answer lies in the second ladder, which extends over a portion of the cliff unscalable except possibly by alpinists. Strong shutter-like doors were folded over the ladder from either side, effectually covering the steps. Only after this contrivance had been unlocked by the ranger's key and the shutters laid back was it possible to proceed up the cliff. Only three persons at a time were permitted on any of the ladders.

With all our party safely up the fourth ladder, we entered the first of the castle's rooms. Coming, as we did, from the glaring sunlight, this tiny cubbyhole seemed to possess more of the attributes of a dungeon than of a castle. It was long and narrow and windowless, save for two small portholes in the front wall just above the floor line.

As our eyes became more accustomed to the semidarkness, we could see that the original wall surface was heavily coated by the smoke and grease of countless cookfires. Multiple fingerprints of the ancient builders were visible in the adobe plaster, where they had been impressed centuries ago while the material was still fresh and yielding.

From this room we passed into others, both larger and smaller. One of them was barely six feet square and so low that none of our party—not even the nine-year-old youngster—could stand wholly upright in it; yet smoke-blackened walls indicated that it had been used for dwelling purposes. All the rooms were poorly lighted, and while many southwestern cliff dwellings are provided with holes to permit the escape of smoke, these had none.

On the west coast we consider sycamore one of the less durable woods, roughly comparable to poplar or willow. How was it then, I asked, that these centuries-old beams were still sound and nearly as hard as marble? The ranger agreed that sycamore wood is quick to deteriorate in a wet, humid climate. "Here in the aridity of the desert, however," he explained, "it is almost impossible to place a time limit on its endurance."

While the ceilings of the rooms all varied in some degree, the general plan seemed to consist of one or two main beams, about a foot in diameter, laid lengthwise. Across these beams were smaller cross rafters. These, in turn, were covered with a thatch of willows or grass and finally with a layer of hard-packed mud. In this manner, the ceiling of one apartment became the floor of the one above. In some rooms, the willow withes had been fastened in position by strands of yucca fiber; and in one room, the thatching medium appears to be corn leaves.

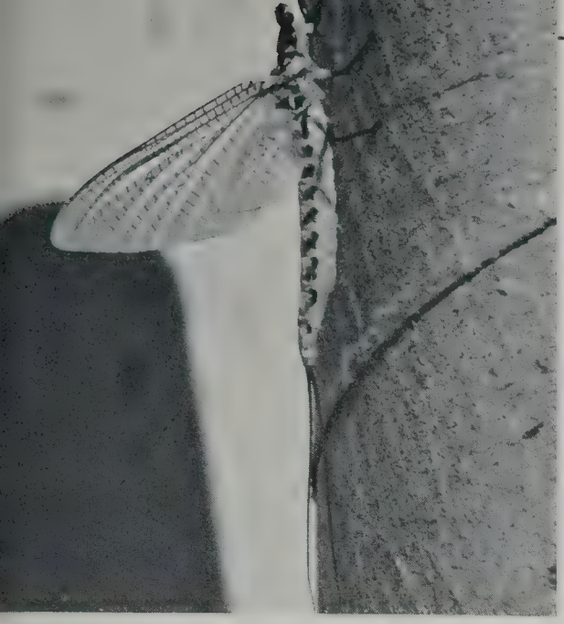
What became of these people? No one knows. Possibly the sporadic attacks of warring tribes from the north increased in fierceness and frequency until it was no longer possible for the cliff farmers to till their fields and produce food. Or, possibly, long centuries of use brought exhaustion to the soil, as has happened since the world's beginning and still is happening where men farm with more attention to the present than to the future.

One factor that may certainly have contributed to the pueblo's abandonment (and perhaps the chief factor) was the unhealthful conditions engendered by dark, smoky rooms, serious overcrowding of population, and absence of all sanitary facilities.

Such remnants of the population as remained on the Verde in the fifteenth century are believed to have made their way north to the Hopi villages, there to be assimilated by the friendly tribe with which they had long previously established trade relations.

As we left the mellow old castle and started the return pilgrimage down the ladders, it came to me with some surprise that I was still completely in the dark on many of the questions about this place that had so long puzzled me. Sometimes I wonder if it isn't pretty much as the late Frank Pinkley, "Boss Ranger" of the National Park Service, once observed.

"The known history of Montezuma Castle," said Mr. Pinkley, "is especially interesting . . . because there is so little of it."



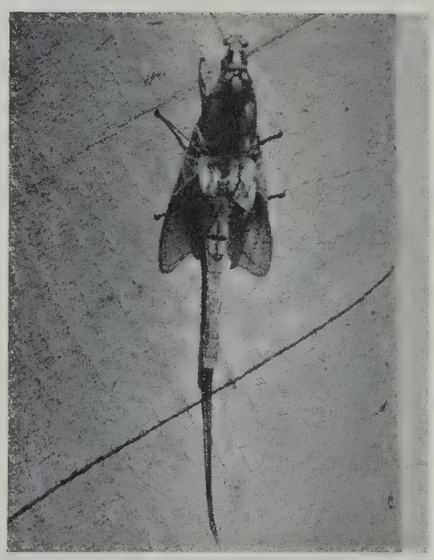
A May Fly SHEDS ITS SKIN

The only insect to molt after acquiring fully developed wings performs for the camera

By Janice Hintz

▲ Here we see the May fly in its natural position, with wings held upright. This stage is called the subimago and precedes sexual maturity

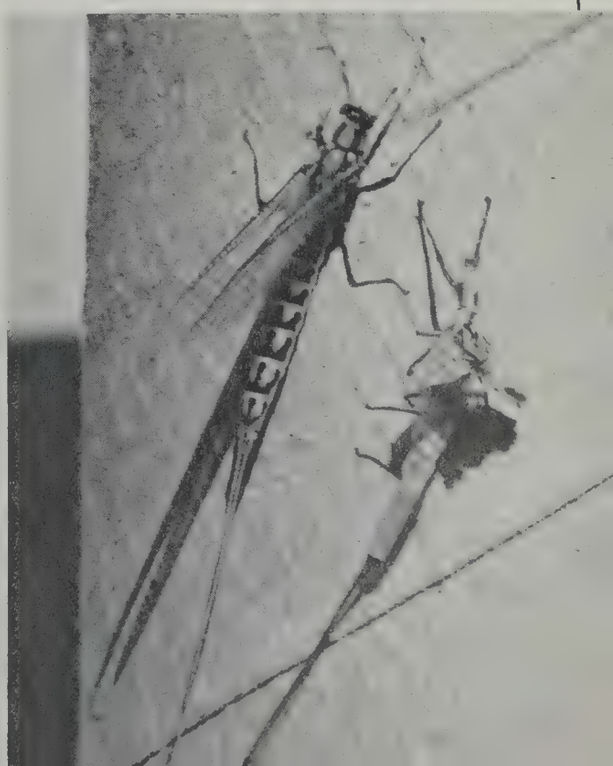
▲ First Step: Just before the May fly starts to shed its skin, it puts its wings down flat and then flits for a minute or so



▲ Second Step: The skin between the wings splits, and the May fly pulls its thorax and head out of its old casing

▲ Third Step: After the May fly has freed its wings and body, it does a back flip. It hangs as if it were dead for a few seconds

◀ Fourth Step: Then it struggles to get upright again. It took this May fly five minutes to shed its skin



▶ All Finished! The May fly emerges from its ghostly skin, shiny and beautiful. Its wings glisten like golden cellophane. The insect waits beside its dried, crumpled skin until evening. Then it flies away into the night

Whistli

THE male Broad-tailed Hummingbird has the distinction of possessing a characteristic that sets him apart from all other birds within his range. All hummingbirds make a humming sound in flight. That is why they are called hummingbirds. But the Broad-tailed Hummingbird may be identified instantly by his unique trilling or whistling sound. He is nearly always heard long before he is seen.

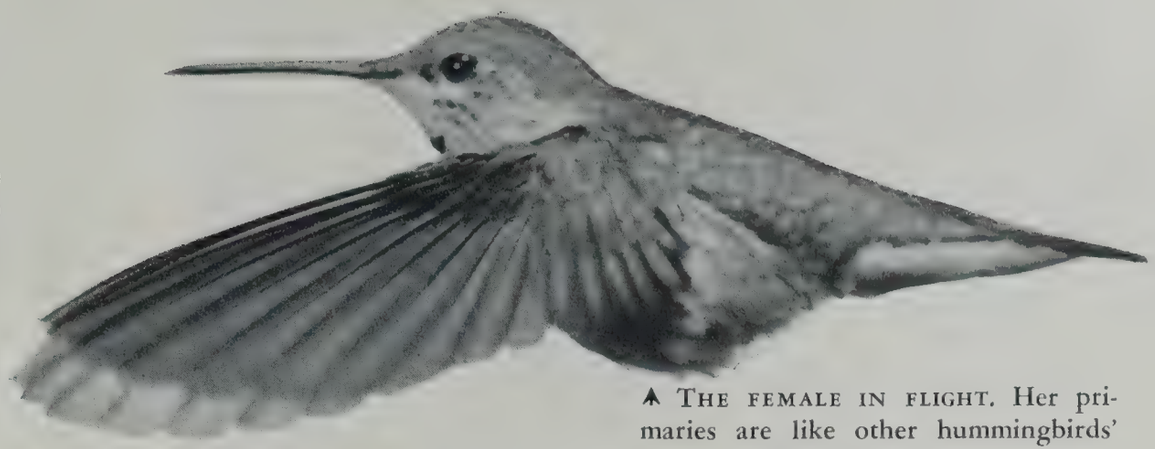
To the observer hearing it for the first time and seeing the bird in action, this seems definitely to be of vocal origin. It has been variously described as "a shrill trilling," "a shrill screeching noise, something like that produced by a rapidly revolving circular saw when rubbed by a splinter," or "a curious, loud, metallic, rattling noise."

Close observation shows that the intensity of the sound is correlated with the rate of vibration of the wings. There is little or no sound when the bird hovers before a flower, the vibration rate then being about 55 beats per second. It is distinctly audible in ordinary level flight, when the beat rises to 75 or thereabouts. And it is loudest in the dive-bombing courtship display, when the rate has been estimated to be as high as 200.

The accompanying pictures are high-speed electric flash shots taken

◄ These three photographs of a male Broad-tailed Hummingbird approaching a syrup cup show the feathers that cause the whistling sound. The first two, or outermost primaries, are shaped differently at the ends, forming a slot through which the air whistles

Wings



THE FEMALE IN FLIGHT. Her primaries are like other hummingbirds'

Though he may not sing a note, you will hear the Broad-tailed Hummingbird before you see him, and you need have no doubt as to who he is

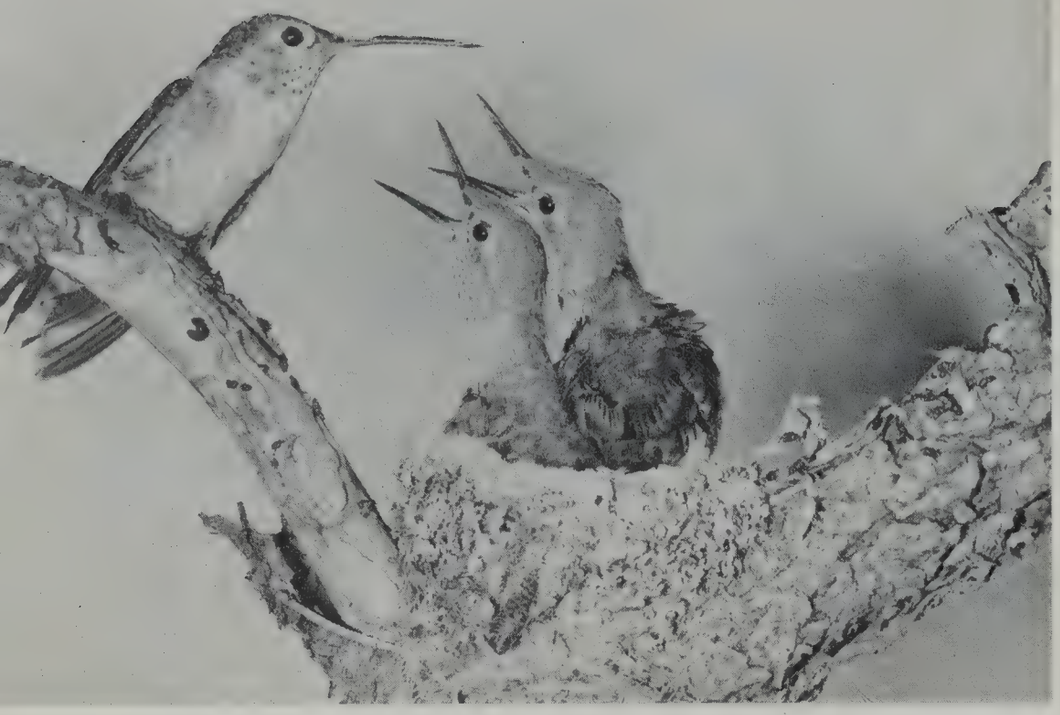
By WALKER VAN RIPER *and* ROBERT J. NIEDRACH
Denver Museum of Natural History

with the apparatus invented by Dr. Harold E. Edgerton of M. I. T., with exposures of about 1/10,000 of a second. They illustrate the differences between male and female wings and at the same time explain the source of the sound. The female in flight makes only the usual buzzing or humming sound of the hummingbirds. When her wing is spread, it is clear that all the primary feathers are normal in shape. In the male, however, the first two or outermost primaries are uniquely modified, being narrowed at the tips to produce the little gap to be seen in the photographs. This is what produces the rattling whistle.

The woodcock possesses a similar apparatus. With him the first three primaries are narrowed and stiffened, and the gaps thus produced account for the loud whistling accompanying the flight love song. This whistling, too, has often been mistaken for "voice." Another bird with modified feathers that produce a characteristic sound is the snipe. In the courtship flight the bird rises to a great height and then plunges earthward in a terrific nose dive, emitting a weird noise that has been likened to the bleat of a goat. That this strange noise is produced by the peculiarly formed outer tail feathers was demonstrated by a Danish naturalist many years ago. He fixed the tail feathers in a weight tied to a string and, whirling it rapidly, reproduced the snipe's bleat.

Just a touch of the same phenomenon is a characteristic of the male of Anna's Hummingbird—the California species. At the bottom of the typical dive, just as he turns upward, the peculiar sound is produced. This has been described as

A MOTHER HUMMER about to feed her young



▲ THE "NORMAL" shape of her wing feathers is seen from this photograph of the female hummingbird feeding her children on the wing. These pictures were taken at about 1/10,000 of a second

The Duke of Argyle, in his *Reign of Law,* demonstrated (by a logical, not an observational, process) that "no bird can ever fly backwards." The hummingbird, he said, might appear to do so when leaving a tubular flower, but in reality the movement is a fall rather than a flight. Many observers, however, have contradicted this statement, and there is not the slightest doubt that hummers can fly in any direction—up, down, sideways, forward, and backward. The bird shown in the accompanying photographs feeding her babies on the wing actually flew backward and a little upward to attain this position. She ordinarily lit beside the nest and began feeding the young, but if she were frightened a little by the camera or the photographer, she would take wing and continue the feeding operation from the position shown. Of the many hummers watched by the writers, this is the only one ever seen to do this trick.

a *klip, plip,* or *speek,* or as resembling the "bark of the California ground squirrel." It has been shown that this is due to a narrowing and bending of the outermost tail feathers.

LETTERS

Continued from page 2

nated "pommel" for the firm purchase of one's finger, and also (apparently because the blowhole was thereby plugged) to make certain that the air-breathing animal would not submerge while being ridden.

W. H. HODGE.

Amherst, Mass.

Blind Fish

SIRS:

Robert R. Miller, in his article "Desert Fishes" appearing in the December issue of NATURAL HISTORY Magazine, doubts the discovery of "authentic blind fish in the fresh waters of western North America," and asks for reliable information to the contrary.

Dr. Miller has evidently overlooked *Anoptichthys jordani,* a blind characin. This fish was discovered in a cave in San Luís Potosí, Mexico, in 1936. Professor Carl L. Hubbs identified it as a new species, probably descended from *Astyanax mexicanus.* This was reported by the New York Zoological Society and the New York Academy of Sciences.

Jordani is about three inches long, is a pale translucent pink, and has rudimentary buds in place of eyes.

ARTHUR M. BLUM.

Brooklyn, N. Y.

Dr. Robert R. Miller of the University of Michigan's Museum of Zoology comments as follows:

I much appreciate the interest shown by Mr. Blum. The expression "western North America," as I use it, includes only the Pacific and Interior (Great Basin) drainages of North America. I am familiar with that remarkable blind characin, *Anoptichthys jordani* and with two closely related species, *A. antrobius* and *A. hubbsi,* described recently from limestone caves in the same region. This area lies inland from Tampico, in San Luís Potosí and Tamaulipas, in the drainage basin of the Río Pánuco, which is an Atlantic tributary. It might also be pointed out that there are two blind catfishes known from the vicinity of San Antonio, Texas, in almost the same longitude as the Mexican blind fish. Again, however, the subterranean waters drain toward the Atlantic.

Let us continue to hope that someone will find blind fish from the Pacific drainage of North America.

A Woodsy Odor

SIRS:

My secretary, Mrs. Helene Gonzales, who happens to be a member of your Museum, called my attention to the front-page article in the *Herald Tribune* reporting the unique idea of scenting NATURAL HISTORY Magazine with a pine fragrance.

Permit me to compliment you; I think the idea is a splendid one. . . . As a hobby, I am immensely interested in the educational phases of our olfactory sense. I find that children are easily stimulated by novel and unusual odors within the aesthetic field, and their comments and reactions are very revealing from a psychological point of view.

For this December you appropriately selected Pine, which is so pleasantly reminiscent of our Christmas Festival. Would it not be possible to scent subsequent copies with specific and exotic plant derivatives and at the same time associate the scent with an interesting story about the particular plant? . . .

ALFRED H. MOELLER.

New York, N. Y.

SIRS:

As a friend and also as a subscriber to NATURAL HISTORY Magazine, I will look forward to receiving my pine-scented copy, reminiscent of the fragrance of the pine woods. . . .

M. FRED CARTOUN.

New York, N. Y.

SIRS:

. . . Regarding the odor impregnation of NATURAL HISTORY, of which I happen to be a subscriber, it may be of interest to you that the process of perfuming magazines originated with me way back in 1937 . . . in *New Ideas.* The print order was 75,000 copies, and the odor was quite strong after one year. We decided against

pine and a number of others, using instead a sort of fruity odor, which we knew would last longer. . . .

HUGO GERNSBACK.

New York, N. Y.

SIRS:

I have read with great interest of the printing of NATURAL HISTORY with pine-scented ink. I am wondering whether it would be possible for us to try a similar venture here at the Eaglebrook School. We have a most unusual press and printing department and are located on a mountainside surrounded by pines. The Eaglebrook School Press is run exclusively for the students. . . . Would it be possible to obtain some of the ink through your printers? No more than a pound would be necessary for our paper at Carnival time next February. . . . I am sure our students would be greatly pleased and their interest in the graphic arts stimulated.

RICHARD DYER,
Director.

The Eaglebrook Press,
Old Deerfield, Mass.

(A pound of the pine-scented ink is on its way to the Eaglebrook printers, with the compliments of NATURAL HISTORY Magazine.—ED.)

SIRS:

Being greatly interested in your initiative in printing an edition of NATURAL HISTORY with scented ink, I write to ask whether it would be possible for you to send me a sample of the Magazine. . . .

JEAN ALEXANDRE.

Algiers, Algeria

DEAR MEESTER:

Please send mine next month widout the synthetic pine from de Maine vuds!!

De "brand" from de cactus in de pine vuds—so pretty on de cover—is especially irritating to my nasal membranes! I sneeze! I headache! I find most perfumes quite irritating to my skin. . . . So please . . . send my next copy widout. Thanks.

MRS. SIGMUND EPSTEIN.

P.S. I apologize, too, to all those who enjoy and like perfume.

New York, N. Y.

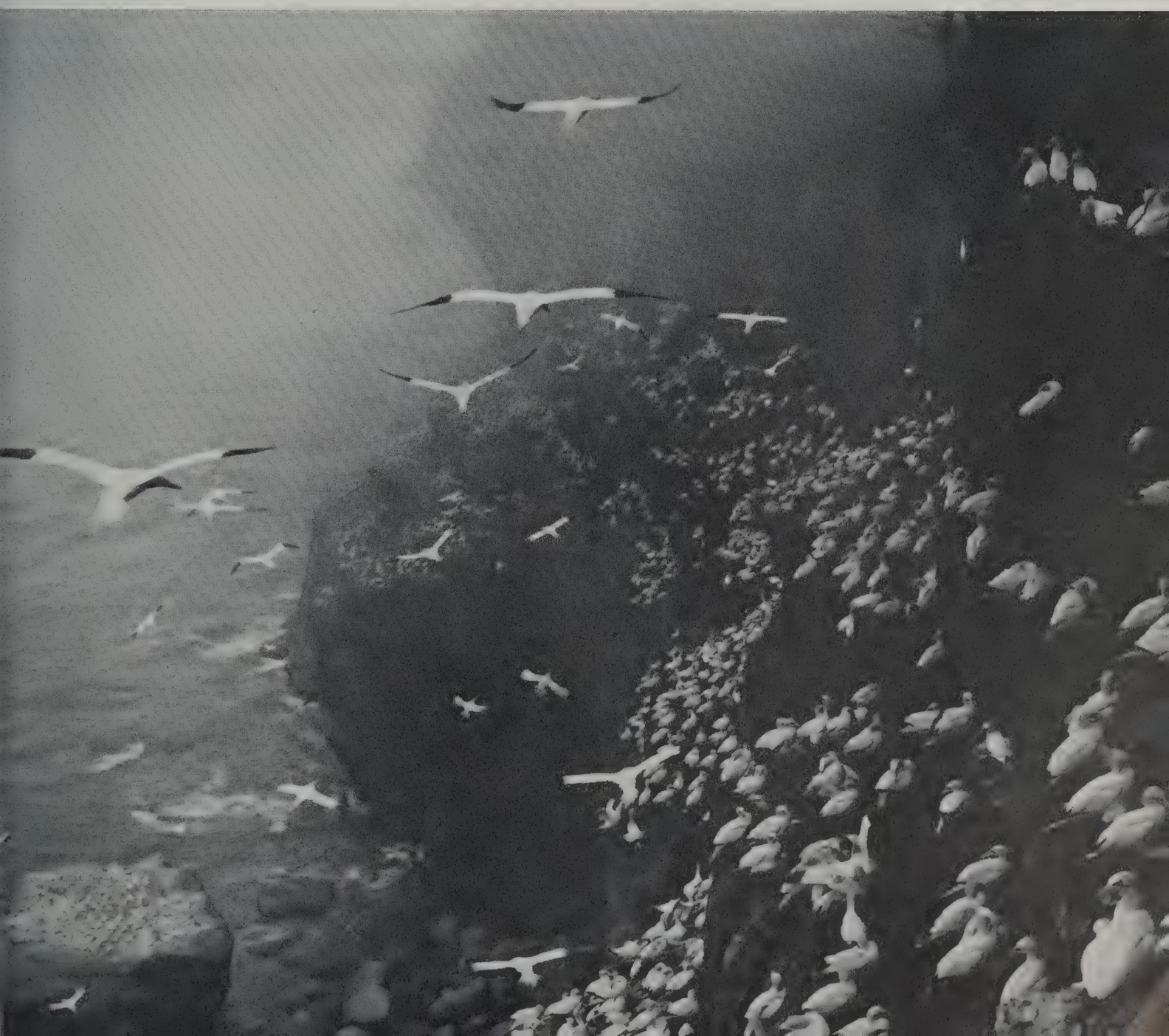
From the Press

"The staid American Museum of Natural History has beat the whole magazine publishing field at its own game. . . ." (New York *World Telegram.*)

"This week subscribers unwrapping their December copies of NATURAL HISTORY were pleasantly surprised. . . ." (*Newsweek.*)

It . . . deserves, we think, the attention and the delighted anticipation of the literate world." (New York *Herald Tribune.*)

ISH-DIVERS THROUGH THE MIST: Gannets of Bonaventure Island in the Gulf of Lawrence, brought to us by the distinguished bird photographer, Allan D. ckshank



Continued from page 14

◄ Sir Peter and Lady Buck, with others of the party, in the place of honor during speeches of welcome. Each meetinghouse is identical in plan, but they vary in design

food as we could eat. At all the feasts that we attended, the food was delicious and abundant. More than that, the joy of hospitality written on each host's face at every pa was beyond anything of the sort I have ever seen. Watching those generous men and women, one was ready to find excuse for the fact that 100 years ago in Maoriland people were sometimes eaten instead of being fed. Was it so much worse to eat an enemy than to torture him with living death as the whites have done: the rack, the stake, the third degree, or the agony of the last war?

In nearly all the village feasts, the food was cooked outdoors in pits—steamed with hot stones—chicken and every kind of meat and fish, including the Maori dish of eels. Once we were served the royal dish of pigeon. It made me sad, conservationist that I am, because the number of wild pigeons is very much depleted. There were vegetables and salads, and brilliant-hued desserts. Everything was good.

At Te Puea's pa, in the evening, an ordinary dance was attended by both whites and Maoris. Without native clothes and rhythms and bare feet, the Maori boys and girls were not a whit more graceful than if they never took their part in the beauty of their native dances.

The floor was cleared shortly after our arrival. The girls took off their shoes and changed their party dresses to bend to unseen paddles in the lovely swaying of the canoe poi dance, their chanting rising and falling to the poi balls, which sounded like paddles in the water. It was the dance of the Tanui Canoe, one of the Fleet whose several canoes are to Maoris what our "Mayflower" is to us. As the dance progressed, dancers bending, poi balls flying, the leader called for quicker, quicker motion: "I see New Zealand! All the power in your human bodies give to these paddles! Land is there!" Every gesture had its meaning in the story. One dancer even depicted a bird that flew past the canoe.

After leaving Ngaruawahia we drove to Rotorua, in the thermal district. From the hill above the lake, we could see the wooded island to which Hinemoa swam to join her lover. We drove through the town past the Maori village of Whakerewarewa, where the people cook over thermal heat and wash in thermal water cooled enough to touch. Here geysers shoot, mudholes boil, and the ground steams. The heat came through my walking shoes, but the Maoris walked there barefoot. Sometimes a child has fallen into the boiling pool from which no person could be saved alive.

We drove to Horahora. Outside the gate a sacred stone is a guide to all the actions of the villagers: the Hinengawari Stone. Out of deference to our waiting hosts, we laid green leaves upon it.

This was a simple pa. The meetinghouse served also as a school. On the wall I saw a childishly-drawn picture of Santa Claus dressed in his furs but in the summer setting of December way "down under."

We visited every kind of pa all over the East Coast, where sandy, golden beaches curve between great headlands. Sometimes the children danced. Once a group of youngsters aped their elders, with one small rascal in a flax skirt to his ankles sticking out his tongue, grimacing, rolling up his eyes in perfect mimicry of older warriors. We saw action dances, boasting dances, furious war hakas, games. Often there were jesting dances, with fun in every movement. These made me wonder if some of the rock pictures found by scientists were done in humor, too. There is one in the Christchurch Museum of a female figure with exaggerated arm and fingers, a real "come hither" picture.

"Dr. Buck," I asked, "do you think that some of those old paintings found in caves are funny? Has any anthropologist ever written on their humor?"

"No," he said "but you can."

I can't imagine Maoris not having a good time, whether they were drawing on the rocks 600 years ago or dancing in their villages today. A child, a wonderful old grandmother with tattooed lips and chin, those so fat they ought to waddle—all enjoy their fun.

Except in sorrow. I saw one boy with arms around a weeping older woman. I have a Maori friend who cannot find a comfort left in life since she lost two children. Everywhere I went among them there was kindness for my deafness such as sensitive people feel.

The study of alien peoples should be far more a part of education than it is. Children would lose the strangeness when learning the similarities and differences of other races. Anthropologists today, in their new and human approach, have already created friendship, co-operation, and interest in their scientific research with the very people they study. It is one more way to bring the world together.

ebruary NATURAL HISTORY 1950

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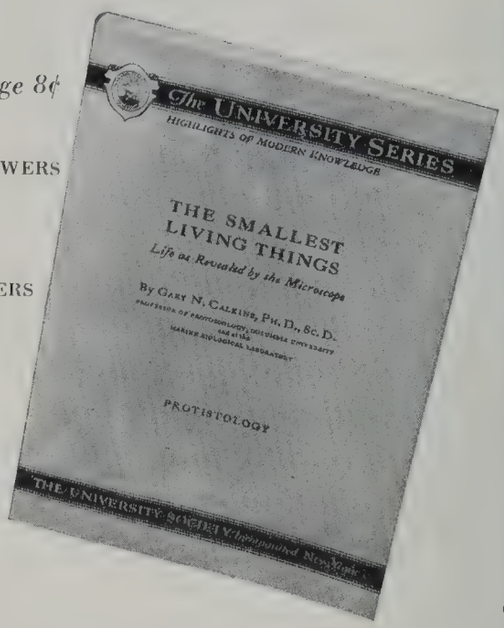
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LETTERS

Siamese Trees

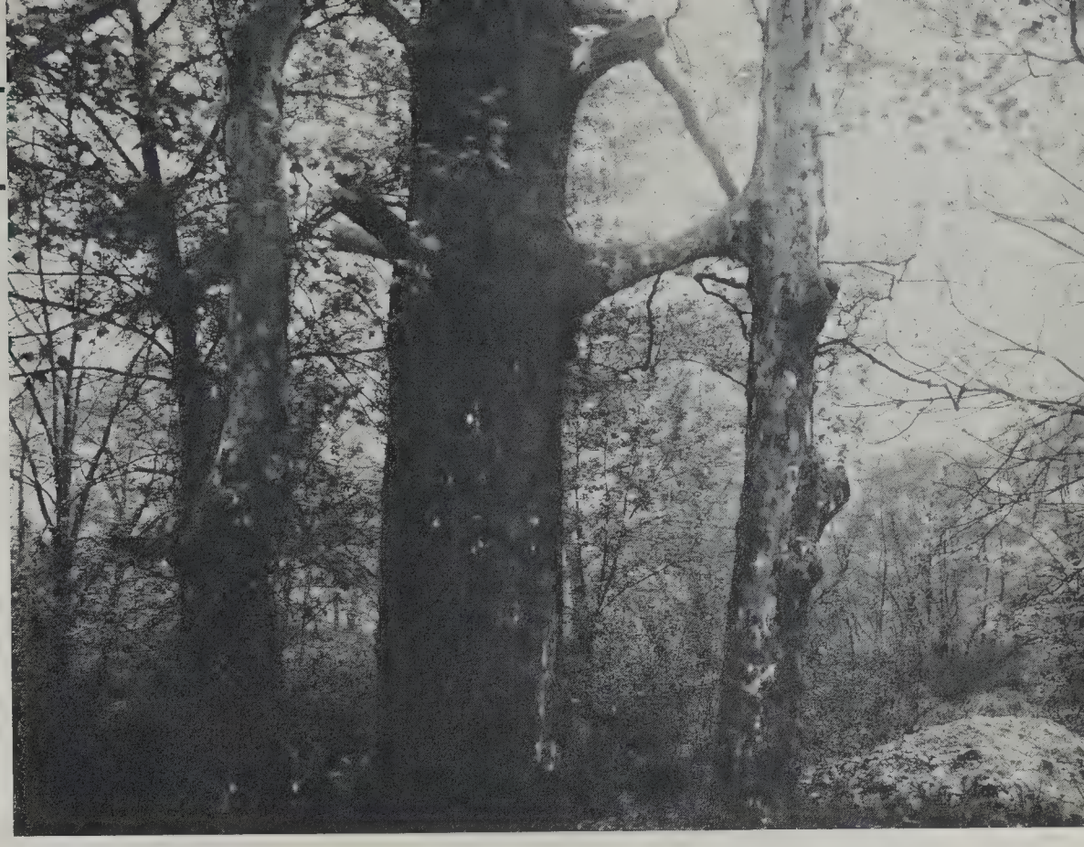
SIRS:

Readers of NATURAL HISTORY Magazine might be interested in these two trees, which have become joined together. They have been thriving for at least 20 years. This curious sight can be seen immediately south of Rutherford, New Jersey. The trees are on the west side of the River Road along the east bank of the Passaic River, a short distance north of New Jersey Route S3.

The link between the two trees is well over head-high, and you will note that some of the limbs have been trimmed so that the trees can show their strange connection to passers-by. Both are sycamores. The grafting of the limb of one tree to the trunk of the other must have taken place naturally.

C. J. BATES.

Englewood, N. J.



Longer Evenings or Shorter Days

SIRS:

If December 21 or 22 is the shortest day in the year, can you tell me why the sun begins to set later each night a week or so *before* that date? This question came up when some of us were discussing the proper date for the end of the year.

The Nautical Almanac shows that the sun reached its southernmost point on December 21 and started north on December 22. But the sunset was at its earliest from December 2 to December 14 in 40° N. lat. So the evenings were getting longer before we reached the shortest day in the year. At the same time, the tables show that we do not get the latest sunrise until after the shortest day—from December 30 to January 12. Could you please explain this?

HERBERT R. SPENCER

Erie, Pa.

Most persons never notice, as Mr. Spencer has, that the shortest day in the year does not *seem* like the shortest day in the year. But the sunlight we have begun to gain in the afternoons prior to December 21 is being lost in the mornings, as his letter implies. This is due to the fact that clocks and watches do not agree with the sun. When your watch says it is noon, the sun may be about a quarter of an hour on either side of its highest position. You can easily prove this by comparing your watch with a sun dial. At one extreme, on November 6, the sun dial will tell you it is noon when your watch reads 16 minutes 19 seconds before noon. At the other, on February 11, the sun dial will register noon when your watch says it is 14 minutes 25 seconds past noon. This difference between clock time and sun time is called the *equation of time*. The eight-shaped figure on some globes, which is known as an analemma, tells the amount of this difference at any time of year.

The reason for this varying discrepancy is that the earth moves at a varying speed in its elliptical orbit around the sun. It happens that around the shortest day in the year, the sun and your watch are quite close together. But during the preceding weeks, the sun has been ahead of your watch and is "slowing down" to meet it. This gives the impression that the afternoons are getting longer, instead of shorter. Of course, if you time the *rising* of the sun each day, you will see that the mornings are getting shorter. In fact, they are losing sunlight faster than the afternoons are gaining it.

After the shortest day in the year, the sun continues to fall behind your watch, and because the day actually *is* getting longer, it appears to be lengthening more rapidly than is the case.

In the tropics, where the length of day varies little, the equation of time really "takes over." Hence on the equator the sun begins to set later in the early part of November!—ED.

North America's Most Violent Quake

SIRS:

I note in your September issue of NATURAL HISTORY some very interesting correspondence regarding earthquakes.

While making surveys in 1927 for a natural gas pipeline from Monroe, La., to St. Louis, our line passed through the southeastern part of Missouri near New Madrid. My attention was called to the so-called earthquake or subsidence that occurred in that section in 1813.

It was reported that the surface settled from ten to twenty feet and that the Mississippi River flowed both ways into an underground cavity. Reelfoot Lake in Tennessee was reported as formed at that time. Further investigation disclosed a U. S. Government report on the subject, I think by the U. S. Geological Survey, which gave many details of the "subsidence." The report quoted data furnished by an English botanist who was investigating the flora of that region and who was present at the time of the "quake."

I conferred at the time with a Jesuit priest, a seismologist at the University of St. Louis, who was in charge of the University seismograph. He spent several hours with me, gave me a five-page report on the subject, and furnished me with a map on which the area affected was outlined.

His seismograph had indicated recent vibrations. He stated that brick chimneys in Paragould and Jonesboro, Arkansas, were still being damaged. His advice was, "Stay out of that country or build a rubber pipeline." The good man was pleased to have someone consult with him on a practical question such as the location of a natural gas pipeline.

This fall we were on a trip up the Mississippi River on the Greenline Steamer "Delta Queen." As we neared New Madrid, we were furnished a bulletin giving the following information regarding the "quake":

"The steamer 'New Orleans,' built by Robert Fulton and sponsored by Nicholas Roosevelt of New York, a great-uncle of a later president, was the first steamboat to make the trip down the Ohio and Mississippi Rivers to New Orleans. Incidentally, she never made the return trip due to lack of power and excessive draft.

"Nearly sixty miles down river from Cairo, Captain Roosevelt noticed that his

boat was going upstream instead of down, although his engines were set to propel her toward New Orleans.

"A forced landing was made but no reason for the strange reversal of the current could be learned. The river flowed upstream for three days and nights.

"When the boat stopped at New Madrid, it was learned that a great earthquake, of non-volcanic origin, had occurred near New Madrid, and the upstream flow of the river was due to its filling a great underground cavity. Today this crevasse is known as Reelfoot Lake."

I would greatly appreciate hearing from Mr. L. Don Leet, Seismologist at the Harvard University Seismograph Station, as he probably has more detailed information on the subject.

FRANK H. SHAW

Lancaster, Pa.

The following comments are offered by L. Don Leet, Seismologist in Charge of the Harvard University Seismograph Station, at Harvard, Massachusetts:

The series of earthquakes to which Mr. Shaw is referring were probably the most violent of any known in North America during the period covered by our historic records.

These so-called New Madrid earthquakes were in 1811 and 1812. The first large one occurred at about 2 A.M., December 16, 1811. The second, of similar magnitude, was on January 23, 1812, and the third on February 7, 1812. For at least a year there were smaller shocks of varying intensity every few days. The region has been subjected to intermittent activity since that time and is regarded as one of the relatively few in the United States in which there is probability of major destructive earthquakes.

The geological environment of these shocks accounts for many of the spectacular surface changes and may be connected with the forces that produced the quake. The region is at the tip of what is known geologically as the Mississippi Embayment, and topographically it is the St. Francis Basin. The Basin is filled with thick river flood-plain deposits of unconsolidated alluvium and is bordered on the east by deposits of loess—very fine-grained dust deposits accumulated by a combination of wind and river action. The heavy shaking of a major earthquake causes landslides, slumps, and extensive general movements in such materials.

Some land areas sank as much as 15 feet, though amounts of 5 to 8 feet were more common. Some of these areas then flooded and became lakes, with the remains of trees dotting their bottoms. Reelfoot and St. Francis are two such lakes. One area, known as the Tiptonville Dome, 15 miles long by 6 to 8 miles wide, was raised 10 to 15 feet above the level of the highest floods.

Elevation here and settlement there, combined with extensive landslides along the banks, resulted in very turbulent conditions in the Mississippi. Strong upstream waves (similar to miniature tidal waves) and associated currents gave the effect of the river flowing upstream. Such conditions may have been repeatedly observed, but I question the report that the river "flowed upstream for three days and nights" to fill Reelfoot Lake. There was a large element of hysteria and superstition intermingled with on-the-spot reports of those days. These included mysterious flashes of fire (lightning from thunderstorms in the vicinity) and sulphurous fumes (marsh gases released by the disturbed swamp areas). The effects were widespread and spectacular but not mysterious.

The largest shock produced vibrations in the ground strong enough to be felt in such distant points as Boston, 1100 miles away. The quake was felt from Canada to New Orleans and from the headwaters of the Missouri to the Atlantic—a total area of about one million square miles.

Hands Across the Sea

SIRS:

Some of the members of our Dutch Youth Association for Nature Study have wanted to start correspondence with young people in various parts of the world. This month we received our first request for an address in the United States. The Dutch Natural History Society suggested that we write to the American Museum of Natural History. We have heard of your wonderful magazine, NATURAL HISTORY. Our members are 12 to 23 years old, corresponding members 16 to 23. We would be very grateful if you would send us the addresses of any young people who might like to correspond with our members.

HANS ANDREAE

Nederlandse Jeugdbond
voor Natuurstudie
Lammenschansweg 47
Leiden, Holland

Any readers of NATURAL HISTORY between the ages of 16 and 23 who wish to establish contact with Hollanders having kindred interests are encouraged to write to Mr. Hans Andreae at the address given above.
—ED.

Palms

SIRS:

As a long-time member of the American Museum, and for several years a member of the Fairchild Tropical Garden, I have been hoping to see something about the Garden in NATURAL HISTORY. There was such a reference in Walter Henricks Hodge's article on Palms in your November issue, but it implied that this is Dr. David Fairchild's own garden rather than one named in his honor.

For many years, Dr. Fairchild had worked toward the establishment in subtropical Florida of a place for the collection and study of tropical trees and shrubs. The organization was incorporated under the laws of Florida and has 850 members. The purchase of the 83 acres of land and the erection of most of the buildings was financed principally by Col. and Mrs. Robert H. Montgomery, whose place a mile south of the garden contains some 400 species of palms—the largest collection in the United States.

I would call special attention also to a feature of Fairchild Garden not mentioned in the article—the 25 acres known as Montgomery Palmetum. More than 300 varieties of palms can be seen there, and the number is being increased every year.

A final word as to the total number of palm species, which Prof. Hodge estimates at nearly 3000. Dr. Liberty Hyde Bailey, addressing a group at the Fairchild Tropical Garden on January 11, 1946, said he had seen estimates ranging from several hundred to 11,000 and added: "No one can say just how many species there are, but I personally am familiar with more than 5000. And they are not mutations of the same or similar palms, but differ from one another as a robin differs from a bluebird."

LEONARD ORMEROD

Miami, Fla.

Does the Cat Come Home?

SIRS:

In the November 4, 1949, issue of the *Herald Tribune*, the following story appears:

"Hayti, Mo.—Yellow Jack, a tomcat, was back with the Clemons children today after a 600-mile, four-month walk from Michigan. Part Persian and the rest just plain alley cat, Yellow Jack originally lived in Benton Harbor, Michigan. Three years ago the cat was brought to Hayti and took a liking to the five Clemons children. His owner took him back last July. He stayed one day in Benton Harbor, Michigan, then disappeared, presumably walking around lower Lake Michigan and down the length of Illinois to the Clemons home in Missouri, arriving on November 3."

Can this story possibly be true?

AMY G. SHUEY.

Jackson Heights, N. Y.

The following comments are offered by Dr. Frank A. Beach, Professor of Psychology, Yale University:

If a cat can walk 600 miles, then the story might "possibly be true." By this I merely mean to imply that Yellow Jack could, conceivably, start in Benton Harbor, Michigan, and eventually arrive in Hayti, Missouri, simply as a matter of chance. After all, thousands of cats must be lost or deserted each year. It is not too much to expect that a fraction of one per cent of this total will accidentally take a course that brings them home.

Continued on page 95

NATURAL HISTORY

The Magazine of the American Museum of Natural History

F. Trubee Davison, President | Wayne M. Faunce, Vice-Director In charge of Publications | Albert E. Parr, Director

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THE COVER THIS MONTH

The largely epiphytic ("tree-sitting") family of the Bromeliaceae is one of the most characteristic and exotic groups of plants indigenous to tropical and subtropical America. Strangely, a single species hails from Africa. "Spanish Moss," (*Tillandsia usneoides*) and the economically important Pineapple are the best known members of this interesting family. Visitors to the Caribbean countries may become acquainted with the plant whose portrait appears on the cover — Pinguin (*Bromelia Pinguin*). Pinguin, or *Piñuela*, as it is sometimes called, is pineapple-like in general appearance and in its terrestrial habit. Its thick, mealy-white spike bears white to pale rose flowers. These mature into yellow, plum-sized fruits with a pleasant though slightly acid taste. The succulent leaves, often six feet in length, possess fine, strong fibers, which are often utilized by aborigines in the tropics for a number of domestic purposes. Probably the most important use of Pinguin today, throughout its range, is as a dooryard plant to form living fences. The sharp, stout teeth that margin the leaves are formidable obstacles to man and animal.

W. H. Hodge

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YOUR NEW BOOKS

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AMERICAN INDIAN SCULPTURE

---------- by Paul S. Wingert

J. J. Augustin, $7.50
144 pp., 7 figs., 76 plates

ALL too frequently are we presented with a discussion of primitive art that combines sound art criticism with anthropological sophistication. Mr. Wingert is an art historian with strong anthropological leanings, and his present book is an important contribution both to fine arts and to ethnology.

The general title is, unfortunately, misleading, since this handsome volume is actually a highly specialized study, dealing almost exclusively with the wood sculpture of the Salish tribes of Washington and southern British Columbia. Although these fine carvings have heretofore attracted little attention as compared with the more elaborate productions of the tribes farther north, Salish art is a mature and developed tradition, representing, perhaps, an earlier basic style out of which Northwest Coast art grew.

Salish wood sculpture consists of carvings in the round and in relief, most of which were of a religious nature and were associated with shamanism. Mr. Wingert wisely discusses these objects against the broader background of Salish culture generally. The body of the book is concerned with a classification of the carvings and with the delineation of tribal and regional styles. The author recognizes five subareas of Salish art, within which he postulates ten "style centers" and seven "major traditions" (based on style and technique). In a cautious historical analysis, he favors an inland, or upriver, origin of Salish sculpture, perhaps in the region occupied by the Duwamish tribe of central Puget Sound.

Although the book is a scholarly study intended primarily for the specialist, it should make fascinating reading for anyone interested in American Indian art. The excellent photographs, many hitherto unpublished, provide a mine of material for the art student and designer. The rigid stylization and stark simplicity of Salish sculpture echoes recent trends in modern art, and the best pieces compare favorably with the now well-known productions of West Africa and Oceania.

HARRY TSCHOPIK, JR.

A NORTH CAROLINA NATURALIST—H. H. BRIMLEY
Selections from His Writings

----- edited by Eugene P. Odum

Univ. of North Carolina Press, $3.50
205 pp., 44 illusts.

THIS book is prepared as a memorial tribute to H. H. Brimley, native of England, who served as a respected employee of his adopted State from 1884 to 1946. In preparing this volume, the approach was to use selected papers from his writings on history and natural history, which were in the files of the North Carolina State Museum. They were prepared by Mr. Brimley in the course of his work to build a Natural History Museum that would attract visitors and teach the fundamentals of the natural sciences.

The selected papers were organized by the editor into six groups, based on chronology and subject matter. To this the editor adds a biographical summary that carries H. H. Brimley in his vocation from youthful naturalist to retirement as Museum Director. The editor has a note introducing each of the groups of writings for the purpose of biographical continuity.

These papers range from commercial egg-collecting in 1880, commercial wildfowling on Currituck Sound, Cape Hatteras, in 1906, the early State Fairs, hunting and fishing episodes, early waste and later conservation of wildlife resources, a native whale fishery, sharks and their behavior, the story of mammoth and mastodon remnants, interesting native birds, and the development of the State Museum until 1928.

Altogether, this is a commendable effort to record the works of one man during a long career. Many admirable facets of a lovable character are not included. Friends will like this book for personal reasons. Students will appreciate a new view of North Carolina during the first half of this century.

HARRY T. DAVIS

ABBE DAVID'S DIARY

----- translated by Helen M. Fox

Harvard Univ. Press, $5.00
302 pp., 16 illusts.

THE Catholic missionary Armand David was one of the great plant and animal explorers of the nineteenth century, and the records of his travels are scientific documents of great value. He was not only a dauntless explorer but a good naturalist who brought back large collections from remote regions of China. To the American layman, he is best identified as the man who "discovered" the giant panda, a remarkable bearlike creature. The extensive diaries of David's three journeys were published in France during the eighteen-sixties and seventies. These journeys lasted four and a half years and took him over much of northern, central, and eastern China.

The present attractively printed and illustrated volume is an abridged translation of the first two journeys; the diary of the third one was not included because the translator considered it less interesting. I disagree on this point and urge completion of a task so well begun.

David wrote with unusual simplicity and clarity, and his writing has not suffered in the expert hands of Mrs. Fox, who, as a matter of fact, demonstrates her own ability in a brief biography of the missionary. The diaries include many interesting observations on plants and birds, and the mammals and other animals are not neglected. David was a good general observer and recorded much of interest about China; unfortunately, lacking the ability to view things celestial from a broad point of view, he made many unduly harsh statements about the Chinese. To his credit, he was dauntless in the face of sickness and other severe discomforts.

Names of Chinese localities and technical names of animals and plants have not been handled well; only some of the former have been changed to the form familiar in English, and only some of the latter have been brought up to date. It would have been better to change all of the place names and leave the animal and plant names just as David used them. A list of

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PICTURESQUE NEW MEXICO *March 2*
by Alfred M. Bailey

An all-color picture of New Mexico, filmed by a famous naturalist in a land of unsurpassed beauty.

OF SHORES AND SAILS IN THE SOUTH SEAS *March 16*
by Charles Allmon

The saga of a vanishing race of Oceania—the story of Tahiti and the Polynesian Islands, brought to you in a spectacular, all-color film.

TRAILS FOR THE MILLIONS *March 30*
by Allan Cruickshank

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NORTH—FAR NORTH TO THE POLAR ESKIMOS *April 13*
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by Wanda Mills

STEPPING STONES IN THE PACIFIC *February 25*
by Alfred M. Bailey

SOMETHING'S ALWAYS HAPPENING IN THE ZOO!
by William Bridges *March 11*

SWISS JOURNEY *March 25*
by Karl Robinson

WILDLIFE IN ACTION *April 8*
by Dr. Olin Sewall Pettingill, Jr.

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recent equivalents could have been combined with an index, and a map certainly should have been included.

CLIFFORD H. POPE

THE COAST OF NORTHEAST GREENLAND

---------- by Louise A. Boyd

American Geographical Society, $6.00
356 pp., 16 maps, 179 figs., plus illustrative material

IN 1937 and 1938, Louise Boyd organized and directed expeditions so that she might continue her exploration of East Greenland. Profiting by her earlier experiences, these were planned with the same objectives in mind. They gave Miss Boyd and the scientists accompanying her the opportunity to explore the coastal zone from King Oscar Fiord, about 72 degrees N., up to Isle de France, 78 degrees N. The report of this work was well along in its preparation when the war broke out. Because a wealth of information about this area was of extreme strategical importance, all the photographs of this and Miss Boyd's earlier expeditions were turned over to our Government and held as restricted information until after the end of the war. After the restrictions were lifted, the reports were finally completed and presented as a special publication of the American Geographical Society.

The sea ice coming down from the Arctic Basin presses in along this part of the coast so as to prevent access by sea throughout most of the year, occasionally throughout the entire year. Because of sudden shiftings in the position of the ice, an expedition in this area must be able to change position and perhaps objectives very rapidly. The expedition in 1938 had a much more favorable season than that of the previous year. An important part of the report has been contributed by Richard Foster Flint, who was the geomorphologist in 1937. He described, and in some cases surveyed, several of the more important glaciers of the area. The results are similar to those in other parts of Greenland. Most important is the fact that the ice mass is in a state of deglaciation at present. The difficulty in interpreting some of the recently formed features should serve as a warning to those investigating Pleistocene problems in other areas. Similar studies were continued in 1938 by Bronner. In his report, more attention is given to the petrology of the area, particularly the metamorphic and igneous rocks. An outline on page 217 is the only attempt to present the geologic history.

The reports on the ecology, botany, and hydrography, including current and tide observations, contribute greatly to our knowledge of the region.

The outstanding feature of the work as a whole is its wealth of illustrations. Miss Boyd has described a technique whereby topographic maps are made from the photographs. Photography seems to be Miss Boyd's first and now her primary interest. Because of her ability, the photographs, both from a scientific and artistic point of view, make the most important contribution to the final report. Many readers of varied interests must commend the scientists and editors for presenting such a readable and informative report.

RALPH L. BELKNAP

THE STORY OF MAPS

---------- by Lloyd A. Brown

Little, Brown and Co., $7.50
397 pp., 84 illusts.

BECAUSE of well-fulfilled responsibilities concerned with maps and cartography at the University of Michigan, the Peabody Institute in Baltimore, and the Johns Hopkins University, Dr. Brown was the man to undertake this work of eminently readable scholarship. He calls it a co-operative venture, but the molding of complex data into simple and beautiful form is his own high accomplishment. This is no book to read in tired moments but rather, for the sake of its thread and charm, in a period of sustained and alert leisure.

The story begins with the daybreak of history, when the earth was taking shape to inquiring man. His early concern was with what he regarded as the habitable world, but speculation soon outran that, and the growth of knowledge became, so to speak, a reflection from the stars. In other words, sound theories of geography progressed along with comprehension of solar and other cosmic phenomena. Accounts of important early contributors, in a chapter entitled "The World of Claudius Ptolemy," have remarkable freshness and clarity, even though the author deals here with subjects and personalities already dimly familiar. Ptolemy (second century) well stated a famous scientific principle, usually credited to William of Occam (fourteenth century), namely, that the best explanation of any kind of phenomenon is the simplest possible hypothesis that does not conflict with the observed facts.

The author's treatment proceeds with chapters on the Middle Ages, the task of haven-finding, the trade in maps and charts that followed the invention of printing, the problems of latitude and then of longitude. The art of determining the last-named component of a geographic fix marked one of the greatest steps in the history of exploration and mapping. It depended upon the introduction of two pieces of apparatus—a telescope and a reliable timekeeper – and scientific cartography may be said to have been born in France during the reign of Louis XIV. Cash prizes of the eighteenth century for means of more accurate determination of longitude at sea (within half a degree or 30 nautical miles) were in amounts up to $100,000 or more. They outdid the bounty of modern radio advertising!

The two last chapters of this book deal respectively with the survey of a country and of the world. They cover mainly the last century and are replete with surprise. As recently as World War II, it was discovered that the earth had scarcely been mapped at all in relation to strategic needs, and that "antiquated" charts, long relegated to library files, were worthy of the utmost respect. A forecast of these circumstances appears in the Introduction to this book, wherein Dr. Brown indicates the ephemeral existence, deliberate concealment or destruction, and high frequency of loss of important maps through the ages.

The book is illuminatingly and excitingly illustrated and superbly documented. It is the kind of dateless source that one must turn to again and again.

R. C. M.

AMERICA THROUGH BRITISH EYES

---------- compiled and edited by Allan Nevins

Oxford University Press, $6.00
530 pp.

I DON'T think it need be emphasized that most people, as well as most nations, have a natural curiosity to know what others think of them. There is, however, a social restraint that tempers the fully candid expression of the way our friends and acquaintances feel about us as individuals which is frequently absent in the impressions that travelers publish about a country. As nations more readily than as individuals, we can enjoy the "giftie . . . to see oursel's as others see us."

We Americans certainly can hardly feel slighted in this beneficence, as Mr. Nevins' book amply demonstrates. The pleasure of contemplating ourselves through the eyes of our British visitors from the beginning

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of the Republic to 1946 is indeed a fascinating one. If we shrink at having our warts, pimples, and deformities described in all their horrid detail, we can expand with the encomiums heaped upon us. Irritation at the misjudgment of our guests can be balanced by the blush from undeserved praise. Then there is always the solid satisfaction of recognition in the just and penetrating analysis.

Mr. Nevins' anthology is a remarkably catholic one, drawing from the well known like Dickens, the Trollopes, Bryce, and Wells and from the forgotten writers who, despite their literary obscurity, often made shrewd or amusing observations. He has assembled his excerpts to cover a vast variety of topics, from pigs in the streets of New York to the cultural manifestations of the nation, from slavery to prohibition, from social customs and manners to political institutions. We catch glimpses of our great; we travel across the country in coaches, river boats, and Pullman; we stop at log cabins, country inns, and de luxe city hotels; we are amazed at our women and appalled at our children; we see our countrymen soberly and industriously at work, full of kindness and good deeds, and avid for literature, and then, with a flick of the page, find them sprawling, lazy, lawless, moving only to spit tobacco juice, and dead to all culture. The choice of excerpts is designed not to shield our sensibilities but to reveal ourselves in the variety of ways in which we appeared to these literate travelers.

Mr. Nevins has divided his samples into five periods, each preceded by a summary analysis of the attitudes displayed by the contemporary writers. Although some themes continue throughout, it is interesting to note the change in orientation as the United States grew in complexity and power. Perhaps the most abusive period was from 1825 to 1845, which Mr. Nevins calls one of Tory condescension. Here is where the notorious book of Mrs. Trollope falls. It is, perhaps, unfortunate that the most virulent attacks upon us have been best and longest remembered, for there have been many notably accurate and sympathetic appraisals of our national character from British pens.

In reading so many accounts of the same subject, one cannot help being impressed by the degree to which each writer unconsciously projects his own personality. Often they are more revelatory of the author's prejudices and conditioning than they are of the object's characteristics.

Although the editor refers to the undiminished flow of British books on American travel, I found on the contrary an interesting pattern in the frequency of their appearance. The bibliography contains almost 400 titles, selected by Mr. Nevins to cover all of the most important items. Although these do not exhaust the list, I tabulated them according to their date of publication and discovered a gradually increasing number, with a maximum of 47 titles in the decade 1850-9, falling thereafter to a minimum of 12 titles in 1890-9 and 12 in 1900-09. In the twenties a minor revival occurs with 33 titles, followed again by a sharp drop. It is tempting to speculate on this curve of production. Does it represent cyclic phases of special interest in us by the British? Or is it merely the effect of developments in transportation?

H. L. SHAPIRO

The amazing life story of one of the greatest explorer-archaeologists in history

Frederick Catherwood, Archt

by VICTOR WOLFGANG VON HAGEN

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• Mr. von Hagen, himself a noted explorer and archaeologist, tells the story of Catherwood's explorations on two continents, his many strange adventures, his associations with famous men of his time in Europe and America, and of the evil star that followed him until his disappearance on the *S.S. Arctic.*

A feature of the book is the reproduction, for the first time since their original publication, of Catherwood's noted series of 24 lithographs—"Views of Ancient Monuments."

208 pages, 64 pages of illustrations, frontispiece in color.

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MAN IN THE PRIMITIVE WORLD

-------- by E. Adamson Hoebel

McGraw-Hill Book Co., $5.00
543 pp., 73 figs.

THE rapid increase in the teaching of anthropology in colleges within the past few years has been accompanied by the appearance of excellent textbooks—so many, in fact, that authors seem to be running short of appropriate names. This title seems a little ambiguous. This most recent book by Hoebel is a comprehensive treatment aimed at undergraduate students and average readers. As anthropology becomes more and more a subject to be taught to undergraduates, and perhaps eventually to high school students more books of this type will be needed.

The book is divided into five parts. Part One is a brief definition of anthropology and a discusion of the subsidiary disciplines. The history of man and his culture are outlined in Part Two. Part Three discusses the races of mankind and gives a very adequate and well-balanced presen-

Continued on page 96

Those Barotse!

An epic journey by a band of African natives, who walked 500 miles in starvation, peril, and exhaustion to join their white friends

By MARGARET HUBBARD*

Hubbard expedition photos by Arthur Mencken and George Noble

COURAGE, HONESTY, AND UNDYING LOYALTY are some of the qualities that win admiration for the Barotse. N'Yambe is here shown bringing long grass to make a camp bed

WE had sold to the Pretoria Zoo all the animals collected during eighteen months in Northern Rhodesia. It was a blow, for we once had hoped to bring them to zoos in the United States. But we were broke. Then our spirits were lifted by a friend's offer to back us in another try, and this time we were also going to take moving pictures of the game.

After months of preparation, all was ready for our move to the fabulous west—to the country beyond Namwala on the Kafue flats, beyond Kowetu, out in the spaces empty of villages toward Mankoya, where the game was thick and undisturbed. Out there, hunters told us, the lions walked boldly at four in the afternoon; and Sajetema, the father of all elephants, whose tracks one knew by the crack across his right hind foot, roamed immune from harm. If he heard natives chopping wood, he came on the run to toss and trample them to death for daring to invade his kingdom; and should a man fire on him, the bullets would turn to water. Or so the natives said. The region sounded like a paradise of game, ideal for our purpose.

We planned to make a base camp close to water, where there was shade and a breeze and where we could plant a vegetable garden and make a home of sorts for the children. If your son were born in Northern Rhodesia and had known nothing but the freedom of the high veld and the constant watchfulness of a devoted nurseboy, it would not seem alarming to go still farther into the bush; so I had no fears. By that time, I was well versed in precautions and the technique of nursing malaria and dysentery; the babies were fit and the rest of us in good condition.

As to lions, leopards, and such dangers, I had learned that the difficulty is to find the brutes instead of fearing they might find us. After all, I reasoned, if great-grandmother once rode horseback from upper New York to Iowa, and if others once took their children across the Great Plains in the face of hostile Indians, why couldn't we go into a wilderness where only the animals were wild and shy? No. We discounted imaginary dangers and took precautions against what few risks there might be. If game were there, as hunters said, we would find it and produce the pictures. If we had a worry, it was about the capacity of the cameraman coming to do the photography. He was the risk, not the game or the country.

We had not considered the impact of another venture such as ours. Far to the north another American had photographed animal-catching by methods so crude and cruel that Africa was shocked and outraged. And although for two years we had had permits to capture animals for zoos, the Governor responded to public opinion and stopped all such operations in Northern Rhodesia. To this day, our predecessor's pictures may not be shown in Kenya.

Yet what of our organization and our hopes and plans? No matter what had happened to the north of

➤ NO TASK was too dangerous or exhausting. *Left to right*: the seventy-year-old Mudalla, who grew "very hungry"; Shilling, who would give his life for the babies; Mengeneera, who tossed a deserter over the fence; and Johnnie, who died of "witchcraft"

➤ A BAROTSE on tom-tom

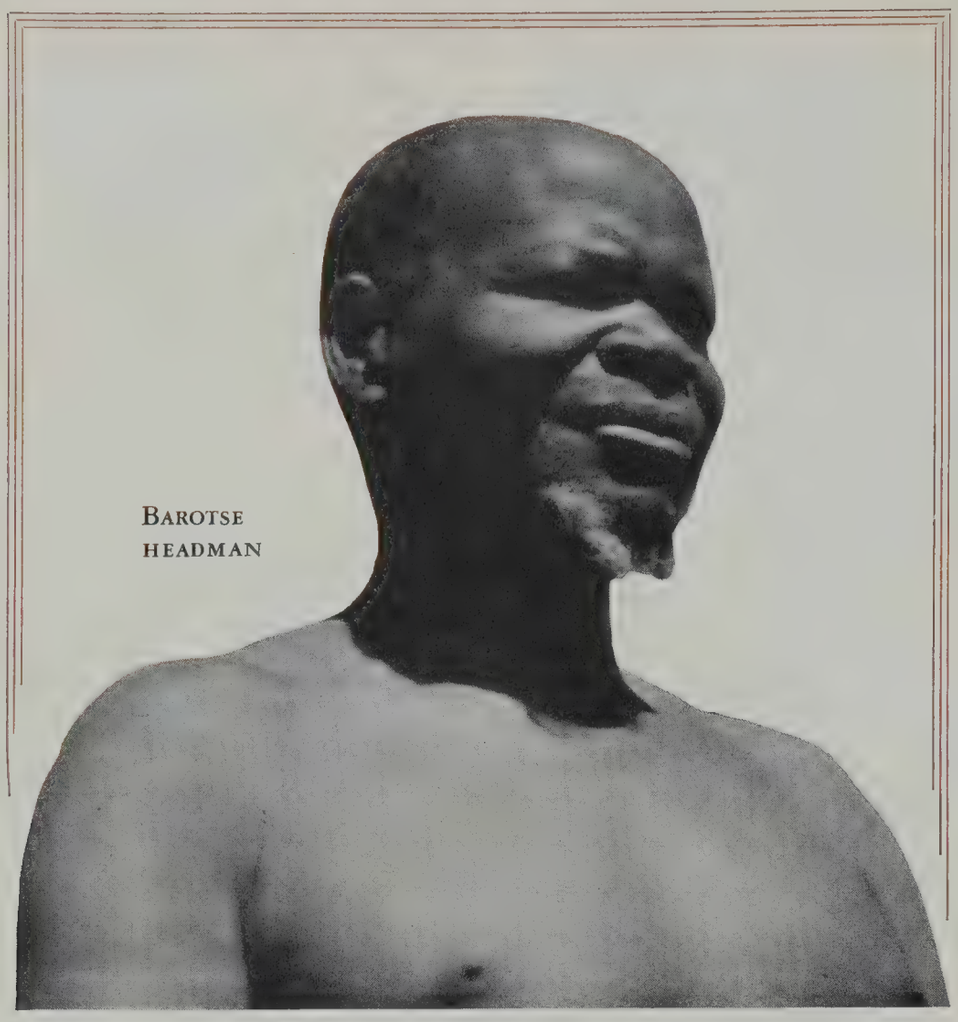
us, we could not give up. This opportunity was our bonanza.

At last we were given permits to photograph and capture what game we wished in Portuguese East Africa, in a territory northwest of Tete on the Zambesi River, where game conditions were said to be unexcelled.

We had, of course, no choice. Surrender was impossible; and at the time no other area was open to us, although the journey would eat into the dry season and the expense of it was an added burden. Nor did we know anyone who had been into the area to confirm the reports of the game, nor did the officials back in Lourenço Marques have any idea of traveling conditions. This was before there were motor roads, and the shortest route to Tete was by rail to Shamva in Southern Rhodesia and thence a walk of about 300 miles overland. From Tete we could work upcountry another 100 miles to the Ruio-Capochi district, wherever that might be. In the opinion of the Portuguese officials it was back of beyond.

Much as we wished, the expense of the move made it impossible for us to take with us all our most dependable boys. After long thought and difficult choice, we named five. I put Tickie first, the nurseboy whom I had trained to care for the babies; then Capaso, the washboy, who doubled as cook, nurse, tentboy, or in any other task about camp. Mengeneera was indispensable as a hunter, and Johnnie was a strapping, fearless Barotse. Charlie, the headboy, ran a peaceful compound and, moreover, came from Portuguese territory, so he was needed.

*MARGARET CARSON HUBBARD has covered Africa from the Cape to Cairo. She has lived in various parts of the continent for years at a time, and her son was born in a mud hut at Tara in Northern Rhodesia. Mrs. Hubbard has written two books on Africa, *No One to Blame* and *African Gamble,* and has made motion pictures of the animal and native life in Northern Rhodesia. She worked with Military Intelligence on African areas and has served as Vice Consul and Economic Analyst with the U. S. Legation in the Union of South Africa.—ED.



BAROTSE HEADMAN

The faces of the others dropped when we gave them the decision. But the next morning seventeen came to us with their thoughts. Mafaeking, another Barotse, stepped forward to act as spokesman. He was an upstanding man with an open face and a determined chin.

"We understand the railroad costs too much money for all of us. But we do not wish to stay behind. If we walk to where the Inkos leaves the railroad, may we go with you? You will need carriers, and we will carry."

"Walk?" We were dumbfounded. As the crow flies, it was all of 300 miles from Choma to Shamva and nearer to 500 or 600 miles by the trail they must follow. There were mountains to climb, up and down the hard escarpment; the Zambesi Valley had to be crossed, where the natives were truculent and big game a possible danger; and then there was another climb to the plateau and Shamva. When they reached us, there would be still another 400 miles to cover, yet they suggested this jaunt of nearly 1000 miles as though it were no more than going down to the corner store.

"You will need carriers," Mafaeking persisted. The group behind him nodded vigorously. "If you can give us salt and tobacco to buy food, we will come. We do not want to be left behind."

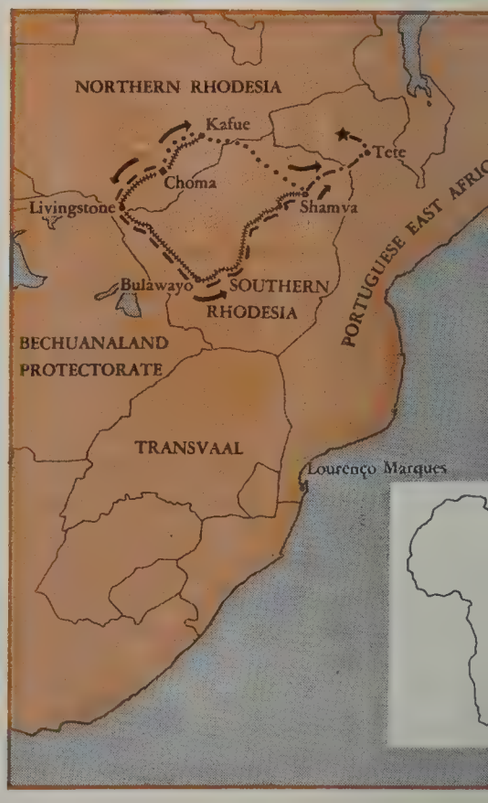
It was not high wages that were luring those boys. We paid most of them the standard ten shillings a month and their food, which could be matched by any employer in Northern Rhodesia. They had more meat to eat in our hunter's camp than on the average farm, but no one, surely, would walk 1000 miles for meat. The fact remained, however, that they wanted to stay with us and we wanted them—the cream of the compound, most of them of the Barotse tribe.

Mafaeking was a good hunter and a good worker. Matches, about seventeen years old, was my cheerful tableboy. There was Saiman, who had a way with animals; and even the Mudalla, of the crumpled shoulder, where a lion had bitten him. He was 70 if he was a day, but the old man grinned and assured us that the walk would be a mere nothing for him. There was his devoted brother, Shilling, and Kapatan, Towelo, Momborowa, and others—the boys we would have chosen if we could have afforded to take them.

Leaving day approached, and we measured out more than enough coarse salt and tobacco to see them through their long trip, and a few shillings apiece to take them up the railroad a short distance to cut 100 miles off their walk.

Two weeks later the railroad was behind us and we were camped on the Mazoe River, in Southern Rhodesia, busily organizing for the long walk to Tete. Our first need was carriers, 50 or 60 of them, to move all the duffel we needed to see us through and to establish headquarters and take pictures—camp equipment, rifles, ammunition, cameras, film, a few clothes, our own food, and food for carriers. A 200-pound bag of meal fed 50 boys for two days. Trade goods—calico, beads, and salt—were needed in quantity to exchange for food on the road, and in addition we would have to carry some meal to feed our boys

▼ FROM CHOMA, the natives foll
dotted line, the expedition the da



◂ KAPATAN (*right*) and another Barotse stripping bark to make ropes before the heroic journey into Portuguese East Africa

▾ MAKING HEAD RINGS from bark for carrying loads

in case we struck a barren area. No one in the district could tell us of conditions on the trail, for no one had made the trip, nor had they heard of anyone who had walked to Tete.

Boys poured into camp from Nyasaland and other points north, looking for work on the mines. Many of them would have taken work as carriers, but when we said we were going to Tete, they lost interest. They would not go into Portuguese territory.

A rough lot, about 20 of them who said they were of the M'Curry Curry tribe and natives of Southern Rhodesia agreed to go with us. But within a few days, when our trade goods began to disappear, we were certain that we faced trouble. There was a thief, or thieves, among them, and our lives depended on having calico and salt to exchange for food. Yet there was no alternative but to keep them on for the sake of their legs and shoulders, which could move our duffel. No boy worth his salt would go into Portuguese East.

One week went by, then two and three, and we began to worry about our Barotse. They should have reached us, unless some misfortune had delayed them.

We had uncovered the thief and put the fear of God into him, but we needed those Barotse more than ever, as a sound core to the good-for-nothings we were forced to hire. Three hundred miles of unknown country lay ahead of us, where there was not a white man, policeman, or magistrate within days' reach, should we need authority to deal with troublemakers. Nor could we desert those boys, although we had no means of knowing where they were, what had happened, when, if ever, they would appear.

Witchcraft! The dread word shuddered through camp when Johnnie, the big, fearless Barotse, discovered he had a tapeworm. Without a doubt, some boy in Barotseland, hundreds of miles away, had put a spell on him. So many things carry death—the chameleon, the rabbit, a snake in the house, a certain kind of snail—before which the boys would cover their eyes in horror and run away. They spoke in whispers, for to speak aloud of the evil would court disaster; nor was it named.

Johnnie thought of his past, thought of someone in his faraway village who bore a grudge. There was no convincing him that he was not doomed, and no word of ours, nor the fact that the worm was removed, put heart into him. Not one boy in the entire compound believed our reassurances. Witchcraft! And there was no witch doctor who knew the medicine to lift the spell. What can a white man know of magic? Ours were empty words, and they watched him, fearfully waiting. The will to die possessed the boy, and when the stars marched across the sky to meet the dawn, Mengeneera came to whisper, "*Ena feelee* [He's dead]."

Johnnie's brothers, the Barotse, had not yet arrived, but Capaso, Mengeneera, and Charlie buried him as a Barotse should be buried. They knew in what position Johnnie should face the east—his legs drawn up as though in his mother's womb.

Of all those in camp, I was the only one who could not pay my last respects, for Johnnie was a man and I a woman, and a man's burial is the business of men. Afterwards, I put a stone on the sad pile of rocks that protected the grave from hyenas and other scavengers, and I had in my throat the same thick lump from which every one of us who knew the boy was suffering.

Five weeks had now gone by, and each day we spoke of the many things that could have happened to the boys we waited to see. At the beginning of the sixth week, when I was looking, as I so often did, up the road by which they should approach camp, I saw some boys coming down the hill, their feet dragging in the dust. Surely it could not be the vigorous boys I knew! They were thin and tired, but nonetheless they were our boys.

Weak voices greeted us. *"Dabonwa Inkossikos. Mabouka Boss."* They sank wearily to the ground, and Mafaeking stepped forward. *"Ena feekilee, Inkos.* [We have arrived.]" We clapped our hands in response to their greeting and waited. They were skin and bones. They had been on the way for six or seven weeks.

"Did we not leave plenty of trade goods?"

"Oh, yes." Again Mafaeking stepped forward, but his shoulders drooped, his face was grayish-brown and drawn. Slowly he told the story.

The morning after we took the train, the storekeeper in whose care we had left what was to be sold, came to the compound and saw the sacks of salt and tobacco and laughed at the boys for liars when they told him we had left those things for them to use on their trip. They would walk to Shamva to join us, would they, and we believed it? We were fools, and he knew natives well enough to know that the thieving bastards would not keep their word. He confiscated the salt and tobacco.

"We had said we would come," Mafaeking continued gravely. "As we said we would do, we took the train to Kafue and started our walk from there. You had given us money for our tickets, and the storekeeper did not know we had it."

They reached the Zambesi Valley and found the villagers starving after a bad year. There was very little grain, and what little they would part with, they sold at a price. A blanket for a mere double handful of grain! They spent the few shillings they had saved from months of pay. They sold their blankets, their shirts, their shorts. They went on starvation rations, but even so they twice lived for three days at a time on roots and grass and water.

"We saw much game!" Mafaeking's eyes shone for an instant. "Where the Kafue and the Zambesi meet, we saw elephant with tusks so long." He measured his arm from his shoulder. "Many of them."

He went on: "The dogs we were bringing you died of starvation, but six puppies were born on the road, and Saiman, caring for them when he had food, saved three."

The whimpering little bags of bones crouched in a bark basket, which he had carried for weeks on an empty stomach. He laid them at my feet.

Shorn of blankets, money, everything but the rags they stood in, they had reached Sinoia, in Southern Rhodesia, and had gone to the Native Commissioner to ask for word of us. All during their journey they feared that we might have given up hope and gone. The Commissioner at Sinoia knew nothing of us, nor of our journey, but they were detained for two weeks. First they were vaccinated.

"We understood that," Mafaeking explained. "We know that all boys coming into Southern Rhodesia must first be scratched against the sickness. But when that was done, we were not allowed to leave." Mafaeking's voice was bitter. "The Bwana made us work. He fed us, but he did not pay us, and he told us you must have gone and that he would find work for us. He told us that if we did not work, we would be sent back to Northern Rhodesia

A FIGHT in Barotseland. In a crisis, 17 Barotse subdued 60 natives of other tribes to quell a mutiny and see the expedition safely into Portuguese East Africa

and that we would have to walk again through the Zambesi Valley. Many white men came to see us. They said they would give us fifteen, twenty shillings a month to work on their farms. Barotse are known." Mafaeking drew himself straight, and pride rang in his voice. "We said that we had work, with you. We said that you would not leave us. So at last we were allowed to go. We have walked seven days from Sinoia, and now we have arrived. That is all."

To look at their gaunt faces was to know that every word of the story was true. Matches looked ten years older—no longer the plump, laughing youngster I had left in Choma. Only the wrinkled, seventy-year-old Mudalla looked much as he had. He still clutched his bundle of spears and still wore at a cocky angle the same wreck of a straw hat with a feather in it. More than once in his life he had pulled his stomach against his backbone, and it would take more than a hungry 600-mile walk to finish him. "I am very hungry, boss!" He clutched his stomach and spread his sardonic grin.

Matches dug down into his *chiapaupau* and brought out a plated silver teaspoon. "You forgot this in Choma, Inkossikos," he told me. "I brought it to you."

I could have cried. He might have traded the spoon for a square meal and I would not have known, or cared.

"Thank you." What was there to do or say in reply to the saga of complete loyalty? We gave them blankets, clothes, the money they had spent, and told them to eat and sleep until they felt like moving. Every face wore a smile. "Thank you, Inkos!" *They* thanked *us!*

Even grief over Johnnie's death could not darken for long their zest for living. They had been hungry, but they were no longer. They had been afraid, but the dangers were past. In three days, they said they were ready to go, and when the packs were lined up, it was those Barotse who took up the heaviest, most awkward bundles.

"Hi! Yi! Yi!" The shrill yips and shouts of laughter, with which they always started a journey, echoed against the hills across the river. "To Portuguese! To Portuguese! *Yi! Yi! Yi!"* Saiman, Matches, Kapatan, and Tickie took up the crib in which the children rode. We were off!

Two weeks later, we should have been well into Portuguese territory, but we had not yet crossed the Luio River and the border. In this rugged, rocky country food was scarce, and we had to trade exorbitant yards of calico for what we could buy. Some villagers even covered the water holes until we paid to learn where they were hidden. We lost days hunting for meat, as most game had left the dry country. Our trade goods were perilously low, and there was muttering among the M'Curry Curry. Without food, and plenty of it, those boys would not carry 60 pounds apiece for many more days, and without carriers we would be stranded days from any place.

We climbed down, down, down from the plateau and came, at last, to a sandy river bed, the Luio. Great oval marks were pressed deep into the sand. Elephant! We wound

Continued on page 93

▲ KASONDA taking a bird from a snare

◀ KASONDA shows the typically open, cheerful face of the Barotse

▲ DARK SPOTS, suggesting a low but persistent form of vegetation, are observed on the floor of the crater Alphonsus (where the arrows would meet). They are known to vary. This is in the south-central portion of the moon

How Dea

Strange occurrences observed by astronomers indicate that the question of life on the moon is not a "closed book"

By PAUL M. SEARS

Photographs courtesy of Mt. Wilson Observatory

s The Moon?

THE moon has long been considered a dead world, airless and lifeless—a world where nothing ever happens. Yet puzzling events occur on the moon, as its devotees well know—events as real and unquestionable as changes on Earth from "fair" to "rainy" or from summer to winter.

However, earthly comparisons are misleading, for the moon's climatic excesses are far greater than the rigorous extremes of our deserts, poles, and high mountaintops. The moon's atmosphere is so thin that its existence is still occasionally doubted by scientists—though not by those familiar with the moon from many nights of observation.

The lunar atmosphere has a surface density only one ten-thousandth that of ours, a gaspingly thin prospect for space explorers. Yet this meager moon-air diffuses the advancing light of the sun and casts a pale dawn over the dark and frozen regions beyond the "terminator"—that is, beyond the line that divides night from day on the moon. To see these elusive dawns and twilights requires patience, knowledge, and rare good fortune. Ten favored astronomers in the last 150 years have glimpsed the lunar dawn as a faint prolongation of the bright horns of the crescent into the dark-moon disc, on nights of exceptional seeing, with the "old moon in the new moon's arms."

Not only twilights demonstrate an atmosphere on the moon. Far more spectacular proof has appeared recently with observations of bright moving specks against the "old moon," which must be luminous meteors in the lunar air. These were discovered not by chance but by careful deduction and painstaking search, reminiscent of the effort that resulted in the discovery of the planet Pluto.

The search was based on the knowledge that eight or ten meteorites strike the Earth each day, while many millions of smaller ones are consumed as luminous streaks in our atmosphere, yielding only a fine metallic dust which drifts down upon us steadily from the stratosphere.

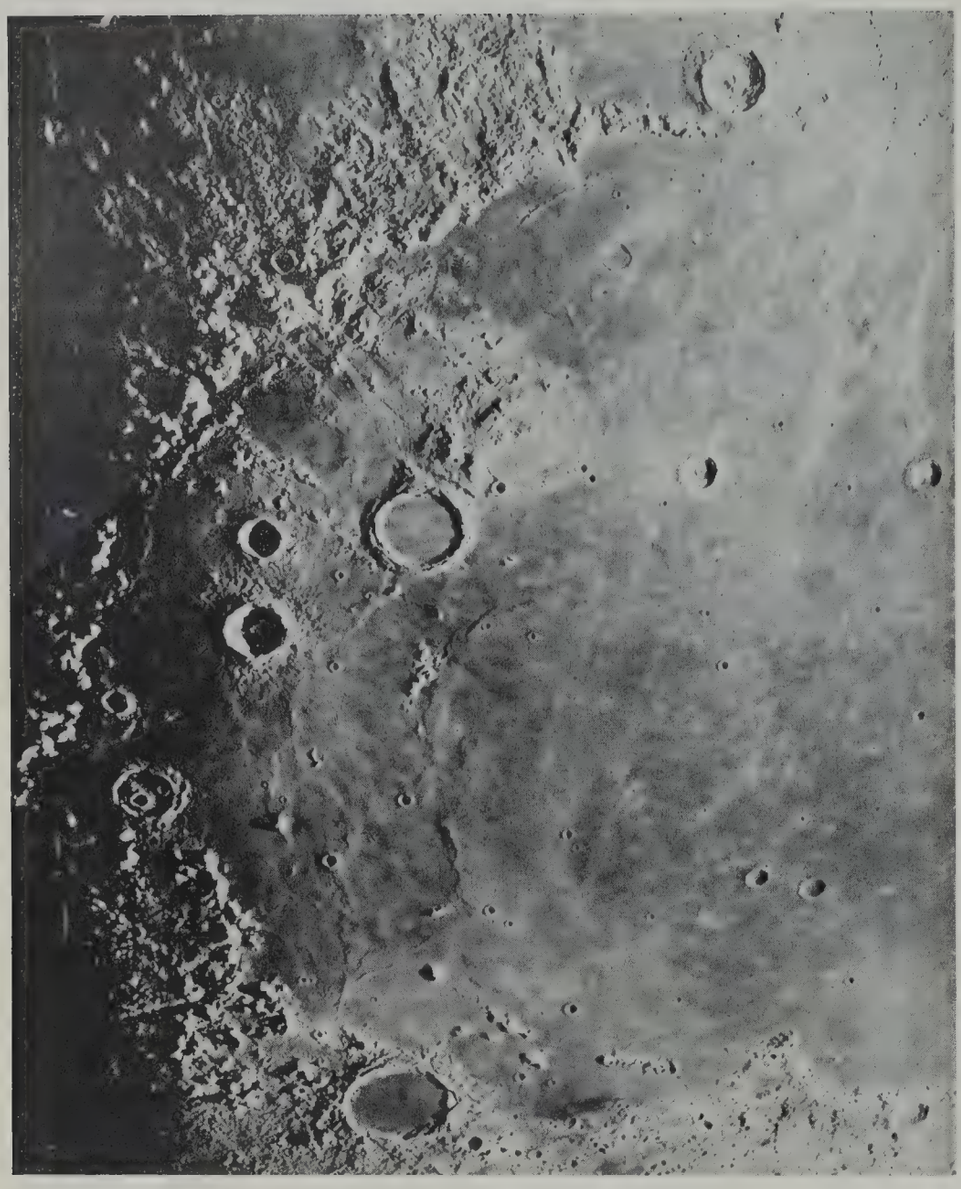
In the 1930's, lunar astronomers began to speculate on the fate of the meteorites which they knew must be striking the moon. Dr. Lincoln La Paz, then of the University of Chicago, made calculations which showed that meteorites weighing ten pounds or more, falling on the dark portion of an *airless* moon, should disintegrate in a flash brilliant enough to be seen with the naked eye from Earth. Over 100 such flashes should occur each year, and they should be seen not only by astronomers but by strolling lovers, outdoorsmen, navigators, and other well-placed observers. We know that such "lights on the moon" are not ordinarily seen; however they *have* been reported two or three times in all human history — just often enough to persuade us to be tolerant of the medieval artists who placed stars within the arms of the crescent moon.

All this was further argument for the existence of the moon's atmosphere, on the grounds that most of the moon's meteorites were being consumed in its gaseous envelope before striking the surface. Indeed, the moon seemed better protected from falling meteorites than the Earth, for, with only one-sixth the gravitational pull, the moon's atmosphere is far less concentrated toward the surface. At some elevation, estimated at between 43 and 55 miles, the atmospheres of both Earth and moon have the same density. Above that height the moon has the denser atmosphere and is thus better able to destroy meteorites at great heights.

The question remained: Might not the meteors flaring through the moon's atmosphere be visible from Earth? Calculations showed that the very brightest meteors on the moon—those that would be reported as fireballs if they occurred on Earth—should be faintly visible through telescopes.

Accordingly, in 1941 Mr. Walter Haas, Publications Editor of the Association of Lunar and Planetary Observers and one of the most experienced students of the moon, began an extended search for lunar meteors. In 170 hours of searching the dark portion of the moon, Haas and his associates detected 12 bright, moving specks which began and ended at points on the moon visible under the telescope. During these observations four or five of our own meteors crossed the telescopic field—meteors flashing in the Earth's atmosphere overhead. One or two of the lunar flashes may also have been extremely faint earthbound meteors coming almost directly toward the observer, but the laws of probability indicate that most of them occurred on the moon.

In addition, the search for lunar meteors revealed two momentary



THE MOON has generally been thought to have no atmosphere, but clouds occasionally obscure parts of the great crater Plato, at the bottom of this photograph. This view of the moon at the last quarter shows the lunar Alps and Appennines in bold relief

bright points of light on the moon, which may have been true impact flares of great meteorites.

There is some possibility that these stationary flares were brief volcanic eruptions, for certainly vulcanism has played a part in the history of the moon. Early astronomers thought the vast dark areas of the moon to be seas and gave them fanciful Latin names such as Mare Serenetatis and Mare Nubium—Sea of Serenity and Sea of Clouds. Better telescopes of more recent years have shown the seas to be rock-paved areas, evidently lava flows, which in some cases breached and half obliterated nearby craters. In places, pressure ridges buckled the surface as the lava lost its fluidity and fell prey to stresses of the disturbed lunar crust.

More debatable is the origin of the 30,000 craters that have been charted on the moon. Geologists, mathematicians, and ballistics experts, as well as plain astronomers, have speculated on the forces that blasted out the craters. The trend of speculation has alternated between two theories—that the craters are volcanic or that they were created by the impact explosions of planetesimal fragments. Perhaps no one theory can account for all the craters; they range in size from pits a few hundred yards across at the limit of telescopic visibility, to huge ringed plains a hundred and fifty or more miles across, with mountainous walls often thousands of feet high.

Indeed, the moon's topography is certainly more complex than the telescope reveals, for the full moon is nine times as bright as the half-moon, and this can only be explained by a highly irregular reflecting surface—perhaps a surface crowded with tiny pits. We must imagine the moon to be a place of precarious footing indeed!

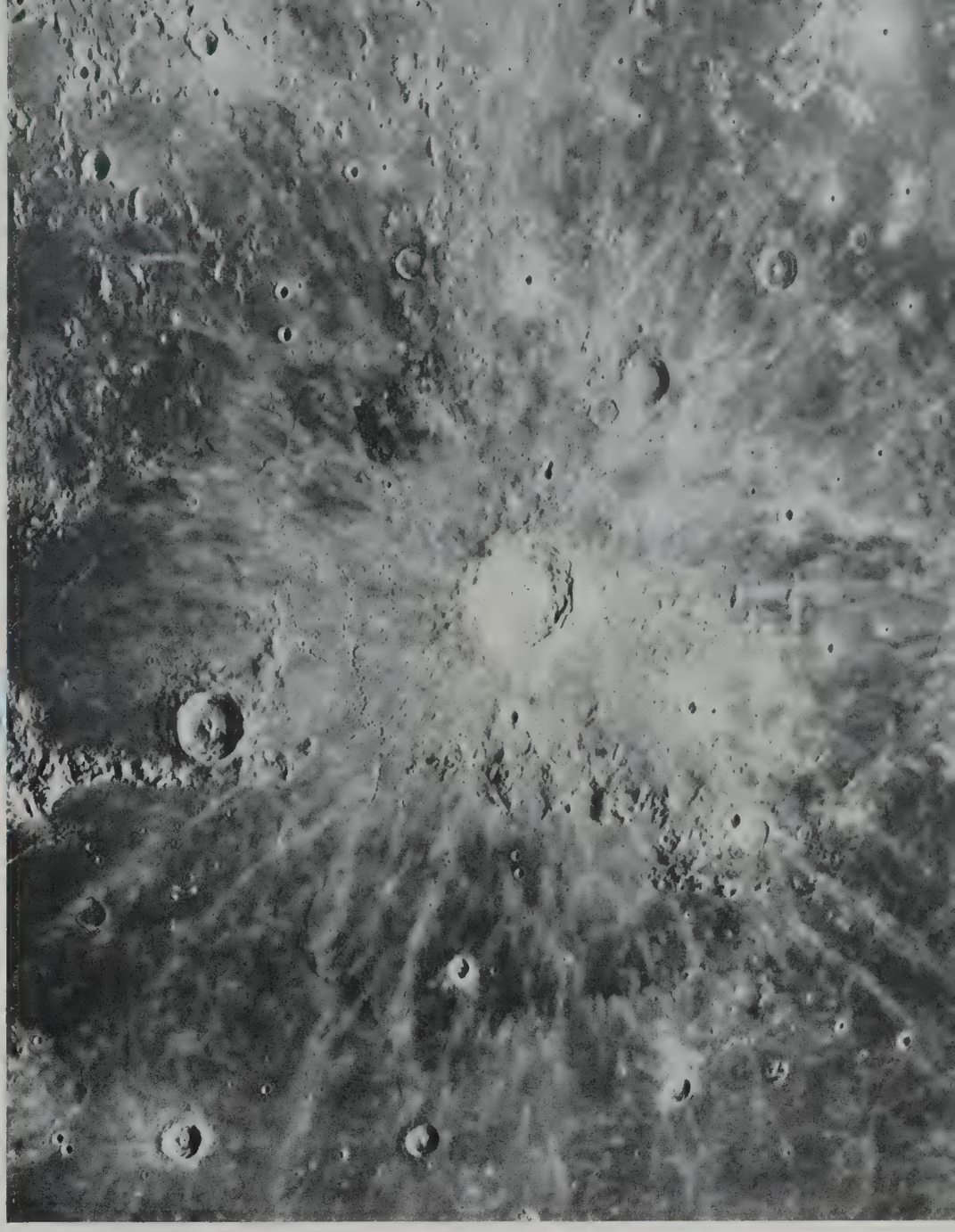
Bizarre events occur in this world of jumbled terrain and tenuous atmosphere. Each month, strange dark areas known as "variable spots" spread and grow, becoming darker relative to the rest of the moon's surface as the sun climbs higher. Some of the variable spots fade again toward sunset; others continue steadily to darken until they are lost in the chill shadow of night. The size and shape of a variable spot may differ from one month to the next, and indeed some spots occasionally fail to appear at all.

The variable spots do not occur in the polar regions of the moon, and they seem to prefer protected sites, such as the depressed floors of the great lunar craters. Their behavior suggests a low but persistent form of vegetation, adjusted to fourteen-day cycles of alternate growth and rest but tolerant of great extremes of heat and cold. Should there be life on the moon, we can expect the lunar day and night thus to correspond biologically to summer and winter of an earthly year.

Faint clouds occasionally drift over the moon's surface, obscuring local details of topography. Sometimes these clouds are outlined on one edge by their own shadow. Lunar clouds are never large, and they dissipate quickly—usually within an hour or so. While the moon scarcely has spells of cloudy weather, the clouds do show preferences for certain regions, which have become famous among lunar observers. Half a dozen astronomers in the last century have seen the mist that occasionally hides de-

tails in the 3000 square-mile floor of the great crater Plato, in the far northern latitudes of the moon. Clouds in certain other craters occur much more frequently.

The surface features of the moon are variously colored, and the colors themselves are changeable. Elusive tints of green, brown, and purple, and more rarely of blue and violet, cover great areas during each lunar month, usually appearing in the same places but varying in extent and duration. Different colors may succeed one another in the same region during the lunar day. Crater floors at sunrise and sunset are usually green; under a high sun they may be green, brown, or purple.



VARIABLE DARK SPOTS appear under a high sun in the crater Eratosthenes, the prominent one to the left of Copernicus in the center of this picture

The craters and mountains themselves are subject to drastic changes. The tiny crater Linné, on the vast lava flow of Mare Serenetatis, has disappeared for months and years at a time and then reappeared with greatly altered dimensions.

Most lunar features show no changes after an eclipse of the moon, but Linné reacts violently to the sudden chill and darkness of such an event. During eclipses the surface temperature of the moon drops from around 214 degrees F. to −143 degrees, recovering quickly when sunlight returns. Linné usually emerges from the Earth's shadow with the bright area around its crater greatly enlarged. The area returns to its customary size only after an hour or more in the sunlight.

Observing the moon is not easy. Changes in the shape and brightness of a single lunar feature require the attention of an experienced observer for an entire year before his findings are credited. The neophyte has no small task merely learning the rudiments of the moon's geography, including the locations of the 600 craters prominent enough to have been individually named. Excellent seeing conditions occur in most localities only two or three times a year. An observer must be alert for favorable nights, when fuzzy spots that have strained his eyes many times before suddenly and briefly clarify into definite craterlets or pits or ridges.

More detail can be seen in any fair-sized crater of the moon than on the entire surface of the planet Mars. These details must be sketched at every observation, for the human eye is far superior to photographs in studying minute telescopic objects. Most astronomers use only one eye for their work, some preferring the right, some the left eye. Seasoned observers are convinced the preferred eye is the only one that "learns" the moon. When they look with their "off" eye the moon seems uncomfortably bright and its detail blurred.

Scarcely one astronomer in six today is on familiar terms with the moon. The great telescopes of the world are employed in the study of distant regions of the Universe, and only scattered observers—mostly amateurs—keep alive the older study of the moon. Their enthusiasm is understandable, for less than one-tenth of the moon's visible surface has been studied systematically. Any persistent observer may discover a startling event on the moon, tonight, or the next night, from his own back yard.

Bir

The exhibit from which these photographs are selected will be open to the public at the American Museum from February 8 to March 5.

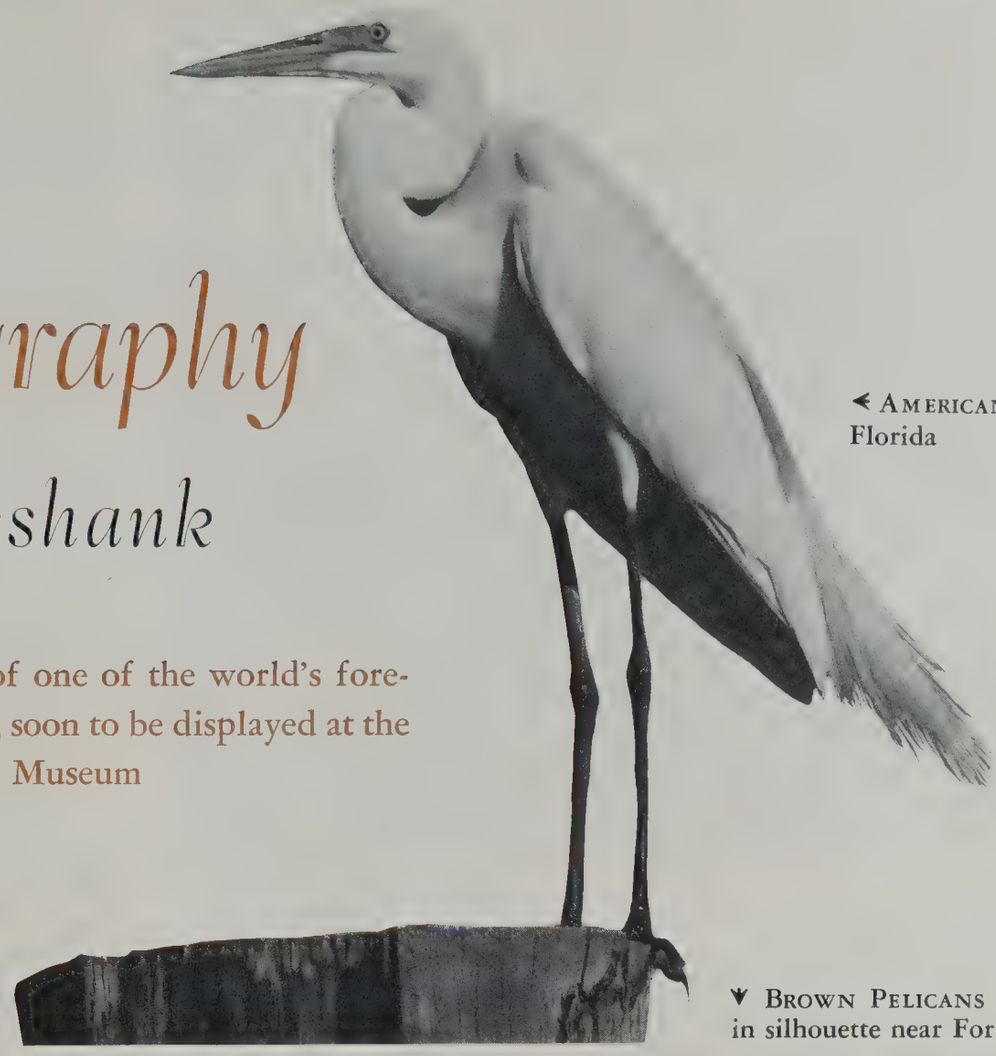
◂ SNOWY EGRET
in the Everglades of Florida

▾ PARULA WARBLERS
at Muscongus Bay, Maine

Photography

an Cruickshank

ections from the work of one of the world's fore-
st nature photographers, soon to be displayed at the
American Museum



◂ American Egret—
Florida

▾ Brown Pelicans
in silhouette near Fort Pierce, Florida

Mme. Eskimo Pro

When the women of Nunivak Island suddenly found an artistic opportunity, fascinating figures ranging from centipedes to whales appeared on their baskets

By MARGARET LANTIS*

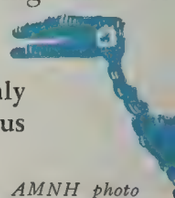
Illustrations from the author's collection

ESKIMO women around the east side of Bering Sea were underprivileged, inhibited, and inexpressive right down to the 1920's —but only aesthetically, one must understand. In everyday chores they were unusually competent and independent, and they certainly were not depressed people. In art, however, they could only stand around and admire the men's creativeness. Men carved and etched dozens of things, from walrus ivory. They carved ornaments; handles for buckets and bags; snow knives for cutting and scraping snow; points, heads, prongs, and foreshafts of long ice chisels; meat hooks and ice hooks; bird spears, fish spears, harpoons, and other implements. They made fancy tubular containers for the women's needles, and above all they carved the amulets, or charms. These were worn on the body and tied on all the hunting and fishing gear. They were carved in the likeness of worms, bears, men, birds, or almost any other creature that could hold and give one some particular power when it was needed.

The men carved wood, too, their most spectacular products being masks as much as three feet high and elaborate in proportion. The wooden dishes, buckets, cups, and spoons, from which everyone ate, were not only carved but painted with animal designs.

And what did the women make? Clothing, skin sewing kits or

▼ BIRDS, INSECTS, and four-footed animals, neatly and artistically woven into the new-style coiled basketry, gave artistic expression to graphic talents originally developed only as childhood pastimes. This is an enormous basket about two feet in diameter



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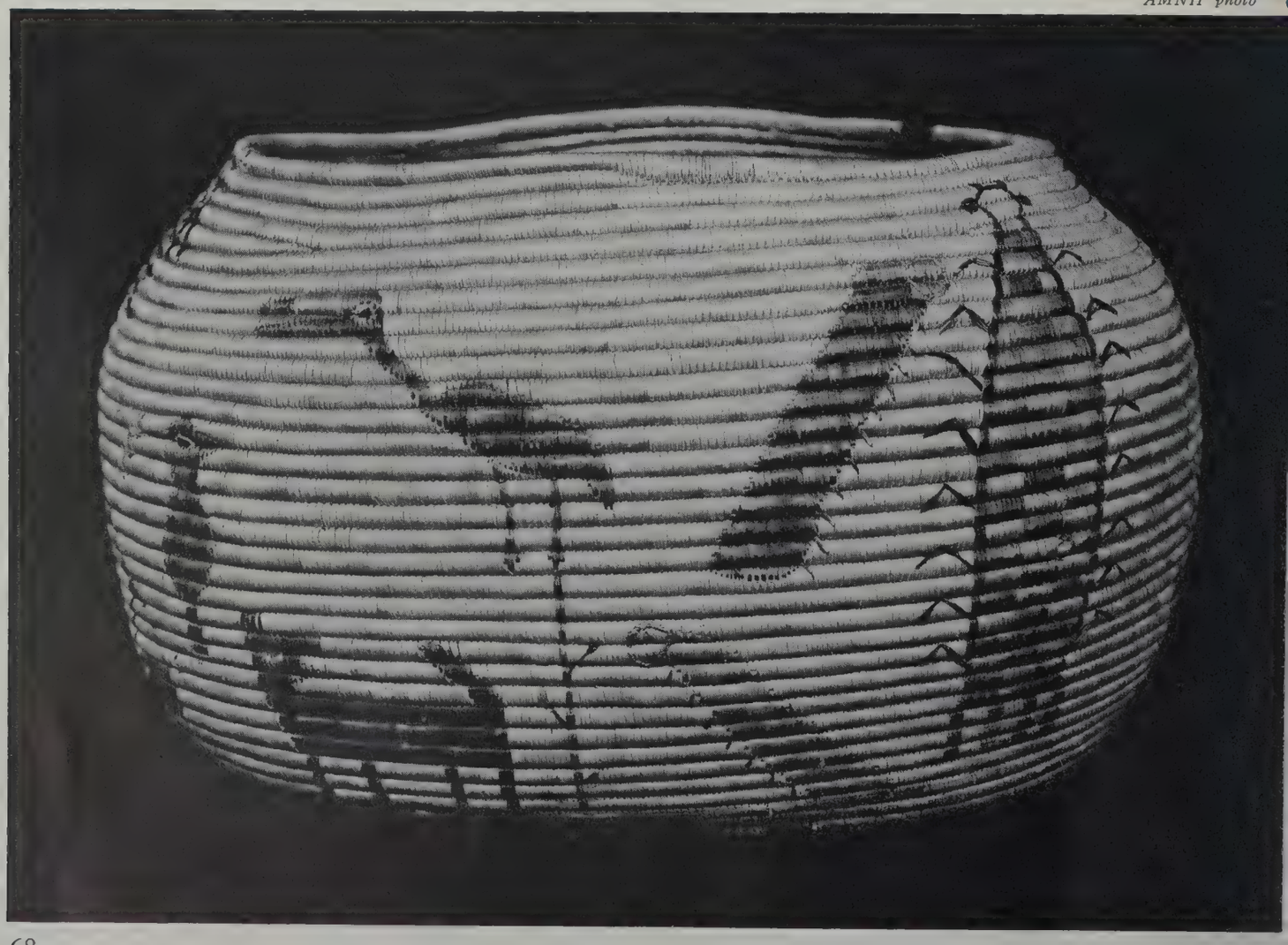
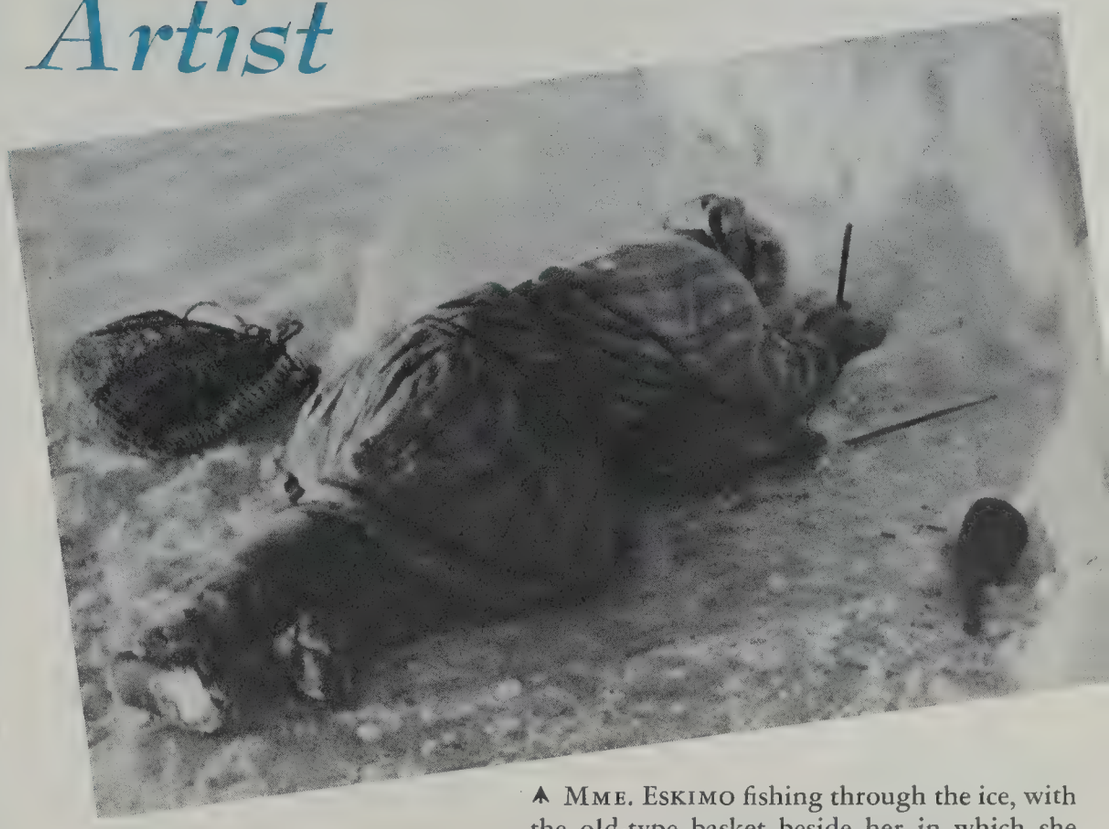


erself an Artist

"housewives," small fur bags or pouches to hold trinkets, and occasionally an elaborate dance headdress. However, before trade brought tiny Czechoslovakian beads, American buttons and red flannel, and perhaps Canadian yarn, the clothing was very plain. Fancy borders on the garments, with designs worked in contrasting colors of "fur" (usually tanned calfskin imported from the States) are familiar today on parkas and boots but were not made in pre-Discovery times.

* MARGARET LANTIS is the author of several important works on the Eskimos and has made two visits to Nunivak Island, including a year in 1939-40 and three months in 1946. Readers will remember her previous article in NATURAL HISTORY for October, 1941: "No Wonder They Worship the Seal."—ED.



▲ MME. ESKIMO fishing through the ice, with the old-type basket beside her in which she will carry home the tom-cods she is spearing

▼ THE OLD-STYLE UTILITY BASKET was always made in the two-strand-twine technique

▼ FRINGED MATS, big and coarse, that cover the dried fish show the long Wild Rye (*Elymus mollis* Trin.) from which most baskets are made

▲ ALMOST ANY FIGURE common to daily experience may be worked into the modern coiled basketry of Nunivak. Naturalistic designs like these were formerly the special privilege of the men

AMNH photo

▲ ANOTHER EXAMPLE of old-style w grass socks from Nunivak, represent era when the women concentrated on c and the men had a corner on the grap

The women had to be content with admiration for their finely stitched seams.

Women did prepare and stitch the skin covers on the kayaks, but men painted the totemic designs on them. Women made skin water-bottles, but men carved neckpieces and stoppers for them. A woman would skin the animal to provide the head for a drum, but her husband or son painted it with the figures of animals commemorating great deeds in hunting.

In one craft, though, the men had no part: basketry. Women made fine mats to cover the inner walls of the house and the sleeping platforms; large coarse mats (that were mostly fringe) to keep flies off drying fish and meat; and a more open-weave but nicely made mat to cover the floor of the kayak. They made carrying-baskets of various sizes and fineness, and small trinket-baskets. As the highest achievement of their weaving, they made grass socks and mittens, to be worn inside the fur ones. These were all done in the two-strand-twine technique. Decoration, however, was simple and severe enough to satisfy the most austere modernist in interior decoration. No mythical creatures, with one side of the face looking like a fox and the other side like a man. No figures of seals twisting to escape killer whale or harpoon. Such realistic art was for the men.

Then, soon after 1920, a trader taught some Nunivak Island women to make baskets in an entirely different technique: by coiling spirally a bundle of fibers and then stitching them one coil on top of the other, instead of weaving them by the twined technique. Women on the neighboring mainland had already learned the coil technique, with mixed and not especially noteworthy results. To the Nunivak Island women, however, here was a new medium of personal expression, and they did not waste the opportunity.

By the 1930's, not only were such familiar objects as dog teams figured on the new basketry; much less obvious and seldom mentioned things like crabs and flies appeared crawling up the sides of the meticulously made baskets. Here are some of the creations, artistic or not: a man carrying a fish in each hand, a crane with a fish in its mouth, cormorants sitting on the water, a mythical spirit with his mouth located on his chest, a Christmas tree (of which there are none on the Island), a red fox sitting on its haunches, a beautifully mobile fish about to be speared with a three-pronged fish spear, not to mention the bees and the buttercups. The attentive, accurate observation for which Eskimos are famous was illustrated again in this new medium.

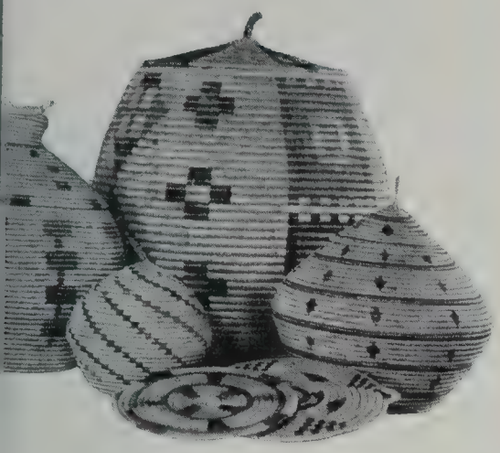
From the alacrity, creativeness, and skill with which the Nunivak women developed and elaborated the new basketry, one might wonder how the naturalistic art of Eskimo culture could have lain latent in the women's minds for so many generations. The answer is that it was much more than latent. It had long found expression in other ways during the formative years of feminine life.

The kind of snow knife that was used in the central Arctic to cut blocks for the snowhouse was used here, where snowhouses were not built, in a fascinating game played by little girls. Father or grand-

➤ STRANGELY ENOUGH, the baskets bearing naturalistic designs like this one do not attract the tourist trade as much as the type shown below

AMNH photo

➤ SIMPLE GEOMETRIC DESIGNS like these appeal to the outsider, though their cultural significance is not so great

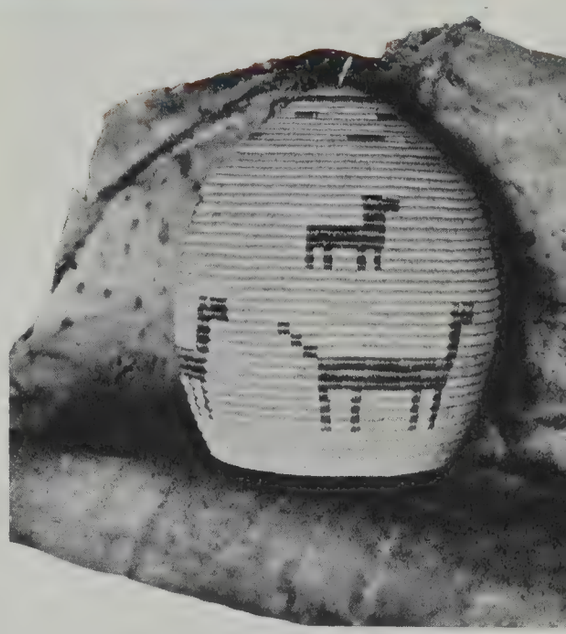


father would carve out the ivory knife and probably etch pretty designs on it. This was the most artistic plaything possessed by a girl. In playing the game, a girl anywhere from five to ten years old would draw, in sand smoothed by the retreating tide or on untrampled snow, as realistic a picture as she could make. If the snow knife was not at hand, she might draw with her forefinger. She would perhaps picture a house with two children inside, a bird-skin parka, a dog with puppies lying beside the house, an old grandmother leaning on a cane. The object of the game was to make other girls guess what specific household, people, or activities the little artist was interpreting. In this example, she had in mind the house of Favorite Daughter, who had two young children and who was busy at this time making a new parka. News items that might not be known to all the children would make the guessing more fun—the fact that the lead dog had recently produced puppies or that granny had just hobbled over for a visit.

The more exact the portrayal, the easier for one's opponent to guess. So one might wonder that the children should not strive for realism in their sketching. In the old days, though, good workmanship was valued highly by the Eskimos in most of their crafts, and good observation was enjoined in everything, even in childhood games. Hence one played to the best of one's ability, just as today the woman carefully delineates a flying bird when she uses imported colored raffia instead of a snow knife in the sand.

Unfortunately, in the 1940's buyers in the States and even tourists in Alaska looked with consternation at the miscellaneous plants and animals sometimes slapped helter-skelter on the sides and tops of the baskets, and bought the more sedate ones with geometric designs. These have been made from the beginning, along with naturalistic designs, and have at last largely triumphed, although they have virtually no meaning in Eskimo culture.

One might wonder whether, as a compensation, the women would not try to adapt the new naturalistic motifs to the old woven style of basket. Apparently there is not a single instance of this. Even the realistic and adaptable Eskimos have their conservative areas of behavior. The twined basketry looks as it did 50 years ago, unless in the past few months some creative genius has made this combination of old and new. There are always surprises though, as when one first encounters a basket nicely decorated with worms. Eskimo women undoubtedly will find, in time, new ways of demonstrating that they are just as observant natural historians as their menfolk.



➤ EXCEPT FOR DETAILS of eye, whisker, or feeler, which are added later, all the figures are stitched on the baskets at the same time as the wrapping of the coils

Josef M

▲ HAVASU FALLS: one of the entrancing spots in the desert paradise of the Havasupai Indians. Note the travertine festoons deposited by spray from the sky-blue falls

CANYON Utopia

It is like discovering a Shangri-La right in the United States to visit the Havasupai Indians, who long ago found an idyllic life in a hidden canyon in Arizona

By PHILIP FERRY

James H. Barbour photo

▲ THE HAVASUPAI INDIANS are friendly and cheerful. They were discovered in 1776 but had little contact with the white man until the present century

THE Supai Indians of Havasu Canyon in northern Arizona have the nearest approach to Paradise to be found on the North American continent. They live in a region of undisturbed wilderness and unsurpassed scenic grandeur. They are wards of the government, and they have no temptations to speak of, since the settlement supports no trading post to dispense those outward manifestations of civilization that might tend to disrupt the fine balance of their tranquil existence. Their tiny post office is perhaps the only one in the country served by pack animal, the mail being brought in over fourteen miles of wild trail from Grand Canyon.

When that brown-robed explorer, Padre Francisco Garces, wandered by chance into the canyon in June of 1776, he found living in that hidden corner of the desert world a tribe of Indians that had never seen a white man. Their legends did not reveal how long they had been hidden in this unexplored tributary of the Grand Canyon of the Colorado. They were the most isolated tribe the Spaniards had encountered in all their wanderings over the great sprawling Southwest.

After Father Garces' visit, we do not hear of the Havasupai again until their canyon was rediscovered by a railroad survey party in 1858. Until early in the present century, there was no regular intercourse with the white man. Then in 1911 a disastrous flood occurred, which prompted the United States Government to send aid and paved the way for a closer contact with the outside world.

Havasu, or Cataract, Canyon, in which Havasupai village is located, is part of the Grand Canyon system, which winds and twists through 100 miles of mesa country amid a veritable maze of smaller but equally enchanting canyons. Some 50 miles west of the settlement known as Grand Canyon, one finds himself in a wildly romantic region in the heart of which lives this interesting tribe of Indians. The Indians call their canyon Havasu, or Canyon of the Blue Water—a highly appropriate name, since the water of the creek is of a sapphire brilliance. The Indians themselves are the Ha-ha-va-

James H. Barbour photo

▶ DESCENT into the hidden canyon is by a steep trail from Hilltop, Arizona, on ponies provided by the Indians

su-pai "The people (*pai*) of the blue (*va-su*) water (*ha*)." This has been compressed until the people have become the Havasupai, or Supai.

To reach Havasu Canyon we turned off U. S. Highway No. 66 near Peach Springs, Arizona, and drove 60 miles across the northern Arizona plateau to a jumping-off place called Hilltop. From this point, a steep trail leads down the red sandstone wall to the village in the canyon below. Over this trail mules carry the few items of food and clothing brought in from the outside world by the fortunate inhabitants of this canyon utopia.

Having motored into Peach Springs, we contacted a representative of the Indian Service, who radioed the agent at Havasu of our coming. By the time we drove the 60 miles from Peach Springs to Hilltop, the Indian riders were coming up the trail to meet us. Riding the familiar small-framed Indian ponies and herding along the pack animal that was to carry our gear, they made a picturesque procession, with the riders silhouetted against the high Red Wall, chanting some ancient tune to speed the animals along. At Hilltop, they tended first to the needs of the animals, then squatted around a small campfire and prepared a substantial meal of barbecued beef, black coffee, and bread.

When the meal was over and they had loaded our gear, we mounted and started down the trail. The trail zigzags down the face of the cliff, then runs for nine miles along the floor of Hualpai Canyon, a tributary of Havasu. It is a dramatically picturesque trail, with red sandstone walls towering overhead. At the junction of Hualpai and Havasu canyons, we caught our first glimpse of the village in its enchanted canyon setting.

The little valley in which the Supai live is merely a wide place in the canyon. On both sides rise perpendicular reddish sandstone pillars, which are known as the Supai Gods. Legend says that when these revered pillars fall, the Supai will disappear from the earth. Through the center of the valley runs the tree-lined creek, flanked by cultivated fields and the wooden cabins of the natives.

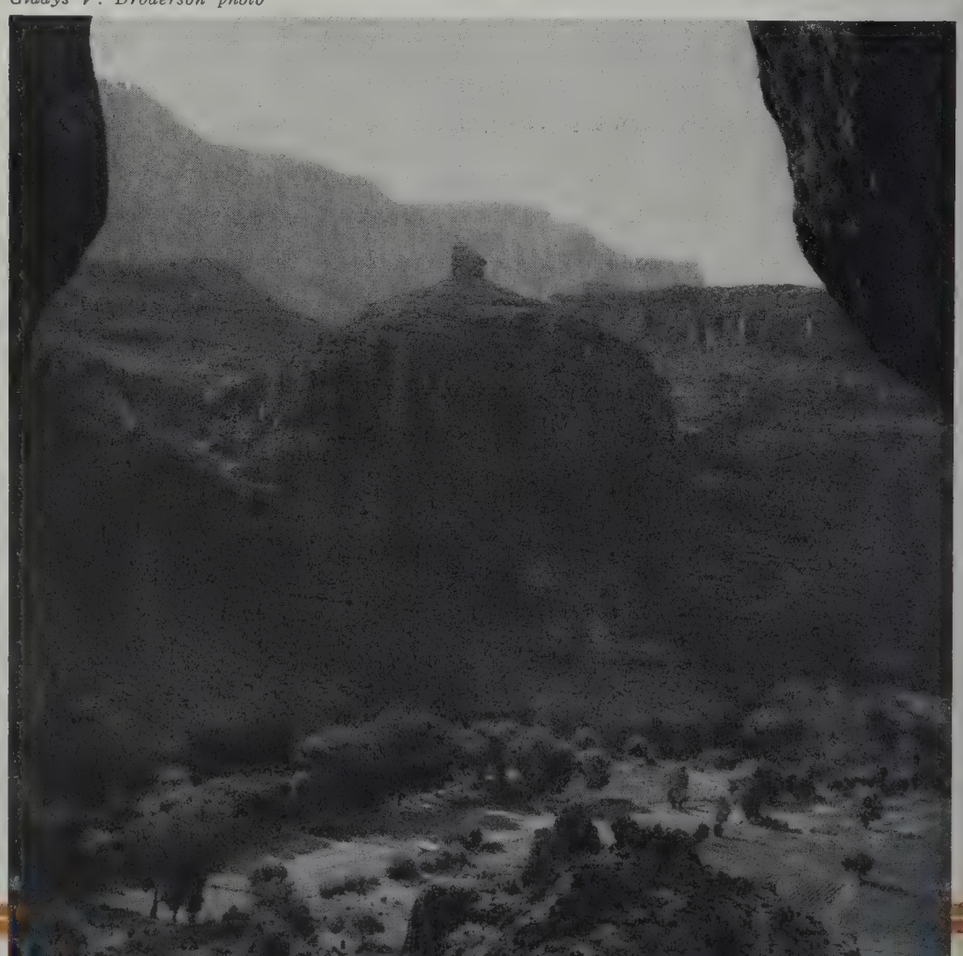
Nature has endowed the Havasupai with a healthful climate, a bounteous water supply, fertile soil that is easy to cultivate, and a degree of seclusion that immediately conjures

James H. Barbour photo

Gladys V. Broderson photo

▲ THE "SUPAI GODS" look down upon the valley from each side. When they tumble from the sky line, legend says the Supai Indians will disappear from earth

Gladys V. Broderson photo



➤ A VIEW of the cultivated fields and cottonwood trees from Apache Trail. At this point, the Havasupai are said to have attempted to halt raiding Apaches

ROM THE RIM, this tortuous tributary of the Grand
yon appears a forbidding homeland even for a
y tribe of Indians

▼ BUT WHEN one spies Mooney Falls and its pool of turquoise water, one gets a taste of the entrancing beauty that lies farther upstream, where the village is located

Alfred Schmitz photo

James H. Barbour photo

▲ A HAND CABLE assists the climber in scaling the cliff near Mooney Falls and in exploring the travertine canopies and caves

up visions of Shangri-La. In addition to these practical assets, Havasu Canyon has a scenic grandeur unexcelled in any section of the Grand Canyon country. Crowning all is the series of enchanting waterfalls and cascades that have given the valley its optional name of Cataract Canyon.

The passage of a century and a half finds approximately the same number of people living in the canyon and tilling the same red soil as in Padre Garces' day. The only outward evidences of exposure to the culture of the whites is in their colorful garments and their wooden cabins, which in recent years have replaced the aboriginal brush-thatched huts and log houses. These homes were provided by the United States Government and are not a gift to the Indians. They were built with the understanding that the debt would be repaid at the Indians' convenience, either in the form of cash or "compensatory labor"—work in the National Park, on the roads and trails, etc. While many of the ancient structures remain, they serve as storehouses, granaries, woodsheds, etc. They are not occupied by the Indians.

Since 1910, the population has fluctuated between 170 and 250. At the present time it is 220. The birth and death rates manage to balance each other rather closely, although an occasional epidemic of measles, dysentery, or pneumonia takes its toll. With this small population, some degree of intermarriage is inevitable, although the Supai claim never to marry closer than first cousins. Of late years the men have taken to going outside to pick brides from other tribes, such as the Hualpais and Navajos, though the latter were at one time their deadly enemies.

The grand lama of this desert Shangri-La is the white school teacher assigned to the village by the Indian Service. This agent, whose official title is Principal-teacher in charge of Havasupai Subagency, is teacher, counselor, and friend.

The agent takes his responsibilities seriously and watches over his wards with the single-mindedness of one whose appointed mission is the saving of these people from unwise exploitation. The Havasupai are a simple people, peaceable and submissive. With the Apaches and Navajos raging savagely over the Southwest in centuries past, the docile Havasupai might well have been exterminated had they not found a secret haven in Havasu Canyon. Luckily, the site provided not only a sanctuary from their enemies but a veritable Garden of Eden as well.

Despite the small number of inhabitants, the canyon is overpopulated for its limited resources, and the Indian Service has under advisement a plan that would make the Supai self-supporting without the danger of disturbing the fine balance of their simple existence.

"We are endeavoring to divert national attention away from the people of Havasu and focus it on the beauties of the canyon," Subagent Guthrie told me, "so that future visitors will come to look at the scenery and not to gape at the inhabitants. Altogether too much emphasis has been placed on the people of Havasu Canyon and too little on the canyon itself. Ethnologists say the Havasupai differ little from the Indians who dwell on the plateau above. In fact, they speak essentially the same language—a dialect of the Yuman tongue. However, in the centuries of their isolation they have developed a manner of life that might be the envy of other tribes.

"The scenic attractions of the canyon, including the picturesque trails, the superb waterfalls, and the dramatic walls, are of a nature to draw visitors from every part of the country. A plan has been submitted to the Indian Service proposing the inauguration of a three-day, all-expense guided tour of the canyon region and the waterfalls. The rate would include use of saddle pony, pack animal, dormitory accommodations, and meals."

There are four beautiful falls in Havasu Canyon named, successively, Navajo, Havasu, Mooney, and Beaver—Mooney being named for a prospector who fell to his death over the falls some years ago. In addition to their great beauty, the falls make the canyon a working laboratory for one of nature's most interesting phenomena. The waters of Havasu Creek are highly impregnated with lime, and as the water evaporates it leaves behind a minute film of lime which attaches itself to everything it touches. When solidified, this material is known as travertine. The deposition accumulates in three interesting forms. The first takes place at the waterfalls. In tumbling over the canyon walls, the water releases clouds of lime-impregnated spray, which dash out on all sides. When the water in the spray evaporates, a minute film of calcium is left on the surrounding canyon walls, on rocks and soil, on trees, twigs, branches, and stumps. Everything the spray touches begins immediately to take on an outer layer of stone.

Strangely enough, these calcium deposits do not necessarily kill quickly. The deposition is so slow

that the process may go on for years before bringing about the death of the tree. However, since the stream flows the year round, the process goes on endlessly. One of the most interesting phases in this process of accretion is the encrustation of logs and sticks. A dead trunk or a piece of wood may in time become completely surrounded by a shell of travertine, anywhere from an inch to twelve inches in thickness. When the inclosed wood eventually rots away, it leaves behind a cylindrical rock shell in the identical shape of the encased object.

A second type of accretion is that in which the creek water builds low limestone dams across the stream. At the base of each waterfall is a series of these low terraces. To step into one of the pools is to stir up whirlpools of the milky calcium deposited on the stream bottom. The runoff channel of each fall is usually a snow-white, calcium-lined trough through which flows a jewel-like turquoise stream. It is this turquoise hue that has prompted the Indians to refer to themselves as the "People of the Blue Water."

James H. Barbour photo

A striking feature of this process of calcification is that, unlike true petrification such as we see in the Petrified Forest, Yellowstone Park, and elsewhere, the deposition in Havasu Creek is not a prehistoric occurrence. It is a living, working procedure going on daily. Here can be seen one of the natural wonders of the world taking form before one's very eyes.

The visitor is not always aware at first glance of the extent of the calcification that has already taken place in the canyon. Great "boulders" that have broken away from prehistoric terraces and hillsides often prove to be masses of calcified material—stone, soil, logs, and branches—solidified into one body and held together by the cementing action of the lime. Between Navajo and Havasu falls is a broad plateau over which the main canyon trail passes. On investigation, this mesa proves to be a massive heap of cemented rubble, riddled with logs and other debris, and situated on the opposite side of the canyon from the present-day stream. Mooney Falls, the most beautiful of the quartette, is set in an amphitheater where the surrounding travertine walls are so honeycombed with detritus that the Park Service, foregoing the usual practice of building a foot trail down the face of the cliff, has dug an approach down through the interior of the soft travertine walls, forming a series of galleries through which a trail descends to the base of the fall.

Here at Mooney Falls is found the most striking example of the third type of accretion. In this instance, the sidewalls surrounding the falls are festooned with hanging stone

◂ MOONEY FALLS, showing the travertine terraces in the pool at its foot

Gladys V. Broderson photo

James H. Barbour photo

➤ A COOL SPOT for a rest, amid the roar and spray of Havasu Falls

➤ HAVASUPAI JUNIOR MISSES, who can't understand why visitors from the outside world are so curious

draperies and filagree work, which are as delicate as if created by a skilled seamstress. These travertine festoons, formed by the lime-impregnated spray from the falls, have the appearance of cascading water that has been instantly solidified into the graceful, curving lines assumed by falling spray. Like a prehistoric stream that has left its imprint in an ancient fossil bed, the travertine seems to have captured likenesses of the waterfalls and printed them indelibly on the walls. In some instances, an entire amphitheater is festooned with an overlapping series of these stone canopies which, like the multiple folds of a ballet skirt, give the effect of water fluttering lightly down the face of the cliff.

At Havasu Falls the deposits have accumulated to such an extent that they have formed a stone hood extending fifteen feet from the wall. This hood acts like a giant umbrella, deflecting the water outward from the wall and causing it to tumble down the face of the cliff without wetting the wall behind. Since the stream has shifted its course several times over the centuries, many of these stone canopies are far removed from the present-day stream.

In one respect, the falls in Havasu Canyon are the reverse of ordinary falls, for they are building up where other falls are wearing down. The waters of Havasu Creek build a calcium "lip" at the edge of each fall. This lip grows higher with time until ultimately a barrier is formed, cutting off the flow of the water. The stream is thus forced to seek a new channel. This action has been going on for ages, and as a result each of the existing walls is surrounded with the evidences of old abandoned channels, with the present-day stream tumbling over only a small portion of the enclosing amphitheater.

Instead of climbing up to visit these falls, one views them first from above and then travels downhill to reach them. The northern end of Cataract Canyon is a double gorge, like the Grand Canyon. The first gorge is a mile wide and a half mile deep and cleaves through the white limestone formation. The second gorge is narrower and only 300 to 500 feet deep and winds through the

James H. Barbour photo

➤ A SWINGING BRIDGE spanning Havasu Creek affords a good view of some of the limestone terraces

red sandstone strata in the bottom. To the northward, the canyon drops away by the series of falls to join the Colorado River and the Grand Canyon. The Indian village is shut in on all sides by towering cliffs, which can only be scaled in one or two places. The village is situated at a high point in the valley. Before issuing as a spring in the canyon wall, the stream passes through several layers of limestone, where it dissolves and picks up the accumulations of lime that are carried downstream to the falls, where they are precipitated in the form of travertine. So heavy is the lime deposit in the region that one of the large side canyons is appropriately named Carbonate Canyon.

The process of accretion taking place in Havasu Canyon is in general comparable to that which forms the stalactites in Carlsbad Caverns. It is also similar to the process of accretion that takes place about the geysers and hot pools of Yellowstone. There, however, colonies of microorganisms, particularly algae, flourish in the more temperate waters, causing the precipitation of calcium carbonate. In Havasu Canyon, the precipitation is clearly the result of evaporation.

The Havasupai have always been farmers. The main valley is extensively cultivated, and each family has its own plot of ground. In recent years the Indian Service has improved the ancient irrigation system, laid out by the ancestors of the present people, by tapping the stream above the village and installing a canal that serves to irrigate the patches of squashes, beans, and corn—all typical Indian staples—and some melons and ancient peach trees. The latter are said to have been brought into the canyon by an early Mormon fugitive who sought refuge there after the Mountain Meadows Massacre. Much of the tillable land yields Bermuda grass and alfalfa, valuable for the ponies every Indian owns.

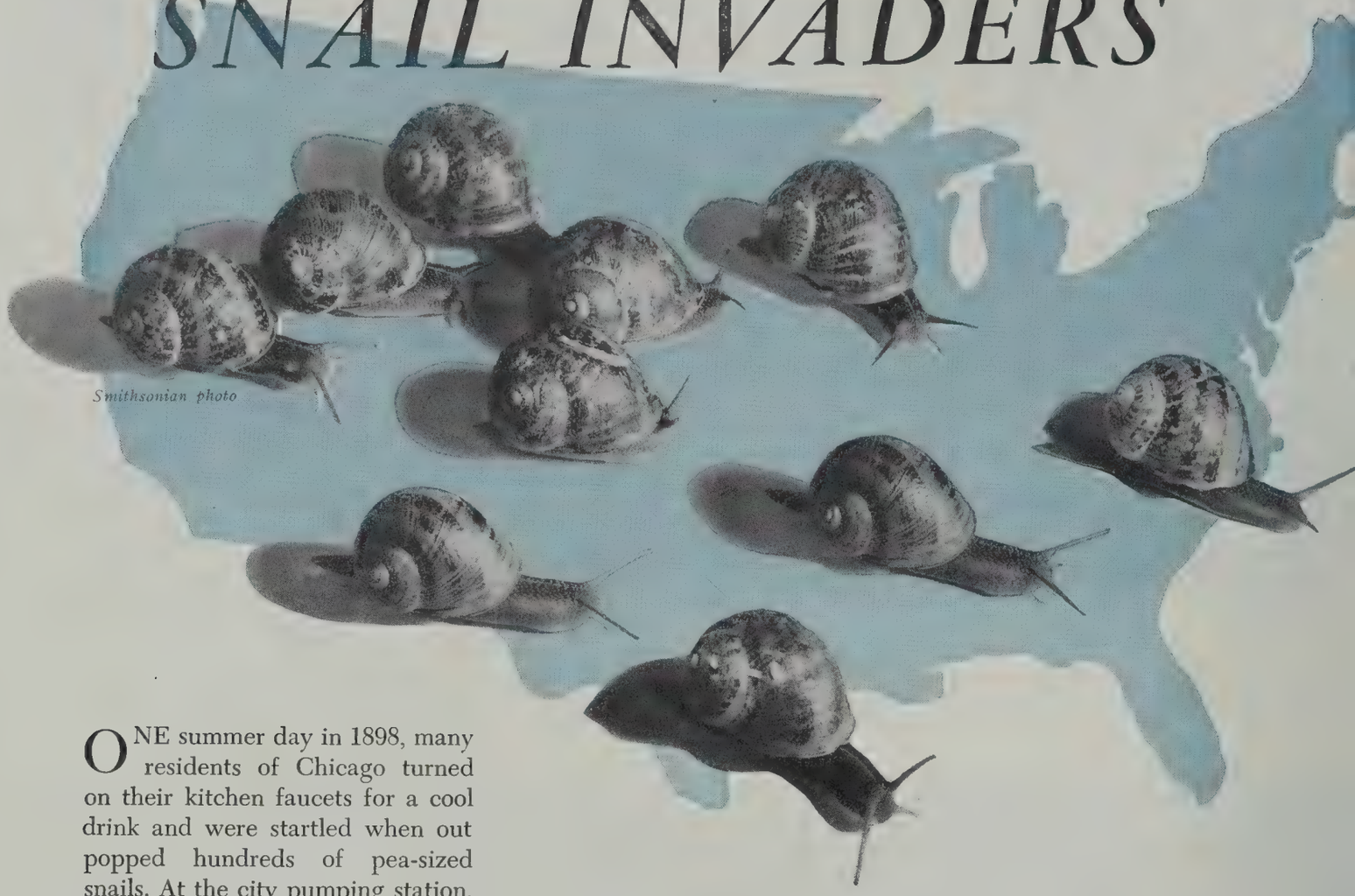
The Havasupai's pride in the ownership of horses poses a problem for the Indian Service. The Indians still reckon their wealth in stock, and a family that will be pinched for till-

Continued on page 92

▼ As it plunges over Navajo Falls, the stream makes music that is unexpected in a desert, and the damp fragrance of greenery urges the parched traveler to linger in the canyon utopia of the Havasupai

Josef Muench photo

SNAIL INVADERS



Smithsonian photo

Already entrenched and Americanized, this "Fifth Column" of alien mollusks, many of which can carry deadly parasitic diseases, is sounding a clear alert to scientists, farmers, and quarantine officials

By R. TUCKER ABBOTT
Division of Mollusks,
United States National Museum

ONE summer day in 1898, many residents of Chicago turned on their kitchen faucets for a cool drink and were startled when out popped hundreds of pea-sized snails. At the city pumping station, millions of these fresh-water snails clogged the wells and screens, and periodically they had to be shoveled out and carted away by the wagon load. Chicago's experience was duplicated in Erie, Pennsylvania, a few years later. Oddly enough, the "faucet snails" were new to most American naturalists, for their known native habitat was, until the late 1870's, limited to northern Europe.

The history of this and similar invasions of the United States by foreign snails warns us of how rapidly an introduced species can spread. In June, 1879, a snail enthusiast by the name of Beauchamp was overjoyed with the discovery at Oswego, New York, of what he first thought was a new species. Further study showed that it was this European snail *Bulimus tentaculatus* Linné, a relative of the one that carries the oriental liver fluke of humans. The initial landing spot will probably never be known, but it was possibly somewhere along the St. Lawrence River in northern New York State. Within 10 years it had mastered the barge canals from Albany to Buffalo, a distance of 300 miles. By 1888, nine years after its American landing, it had broken out into Lake Erie and established itself at Ashtabula, Ohio. From its lake beachheads it moved inland a year later to Sandusky, Ohio, and into the marshes of Toledo, Ohio, by 1911. About 1891, it had extended its range westward into Lake Michigan, striking Black Lake, Holland, Michigan, in 1891, where it was reported as "spreading rapidly." It had reached the Lake View waterworks at Chicago in full force by August, 1898.

In the meanwhile, consolidation was being accomplished in Erie, Pennsylvania, where older residents may still remember the episode of the "faucet snails." A pincer movement was initiated against New England in 1890 with the invasion of Burlington, Vermont. The snails were in the Thousand Islands by 1911, in Cornwall and Toronto, Ontario, in 1913, and in Washington, D. C., by 1927.

Within the last 100 years, approximately 45 immigration visas have been issued by nature to molluscan aliens. A third of these we would like to deport as undesirables. Our greatest concern is not with the foreign slugs and garden snails, though they have cost us millions in crop damage and control measures. It is not even with the threat of the ravenous giant

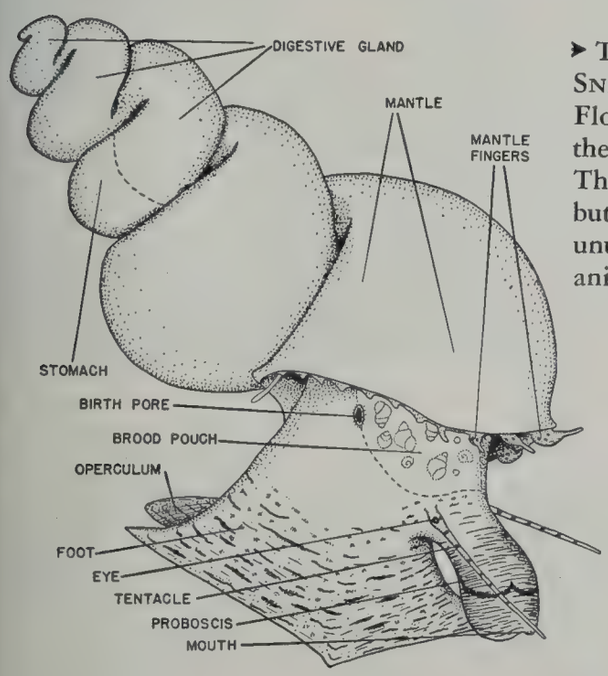
African snail, which has been recently knocking at our doors at both Atlantic and Pacific coast ports.* Our guard is up for the potential entry of oriental fresh-water snails that carry deadly parasitic diseases of man.

One of the most recent and successful invasions has been made by a small aquatic snail that is capable of carrying the human lung fluke, a parasitic worm of the Orient. Until recently, this so-called Thiarid snail, *Thiara granifera* Lamarck, was limited to the Far East and the western Pacific Islands. Today, it literally paves the sandy bottom of Lithia Spring, Florida, and may be found crawling happily about many a home aquarium throughout the country.

Technically known as paragonimiasis, the disease that may be carried by the Thiarid snail is not to be treated lightly. When the adult worms are attacking the lungs, the symptoms are not unlike tuberculosis or broncho-pneumonia. The disease is insidious at its onset and chronic in its course, with chills, fevers, chest pains, persistent cough, and bloody sputum. When working on the brain, the fluke is responsible for symptoms that have been mistaken for infantile paralysis or meningitis.

Nature was in one of her experimental moods when she evolved this parasite and dictated the complexities of its life cycle. The plump adult worm is about half an inch long and customarily lives encased in pockets of the lungs. The eggs of this lung fluke are coughed up and, upon reaching fresh water, hatch into microscopic, ciliated organisms called miracidia. These tiny swimmers are attracted for some unknown reason to Thiarid snails, into whose flesh they penetrate. Several weeks are spent in the snail, during which time a process of multiplying and developing goes on, which results in the production of another type of tiny swimmer, the cercaria. These must seek out and enter certain species of fresh-water crabs or crayfish in order to continue their life cycle. Within the flesh of the crabs, the larval flukes roll up into pearly-white cysts and await the day when some hapless person or animal eats the crab raw. Once inside the stomach of the mammalian host, the organism is certain to develop to adulthood and migrate to the lung.

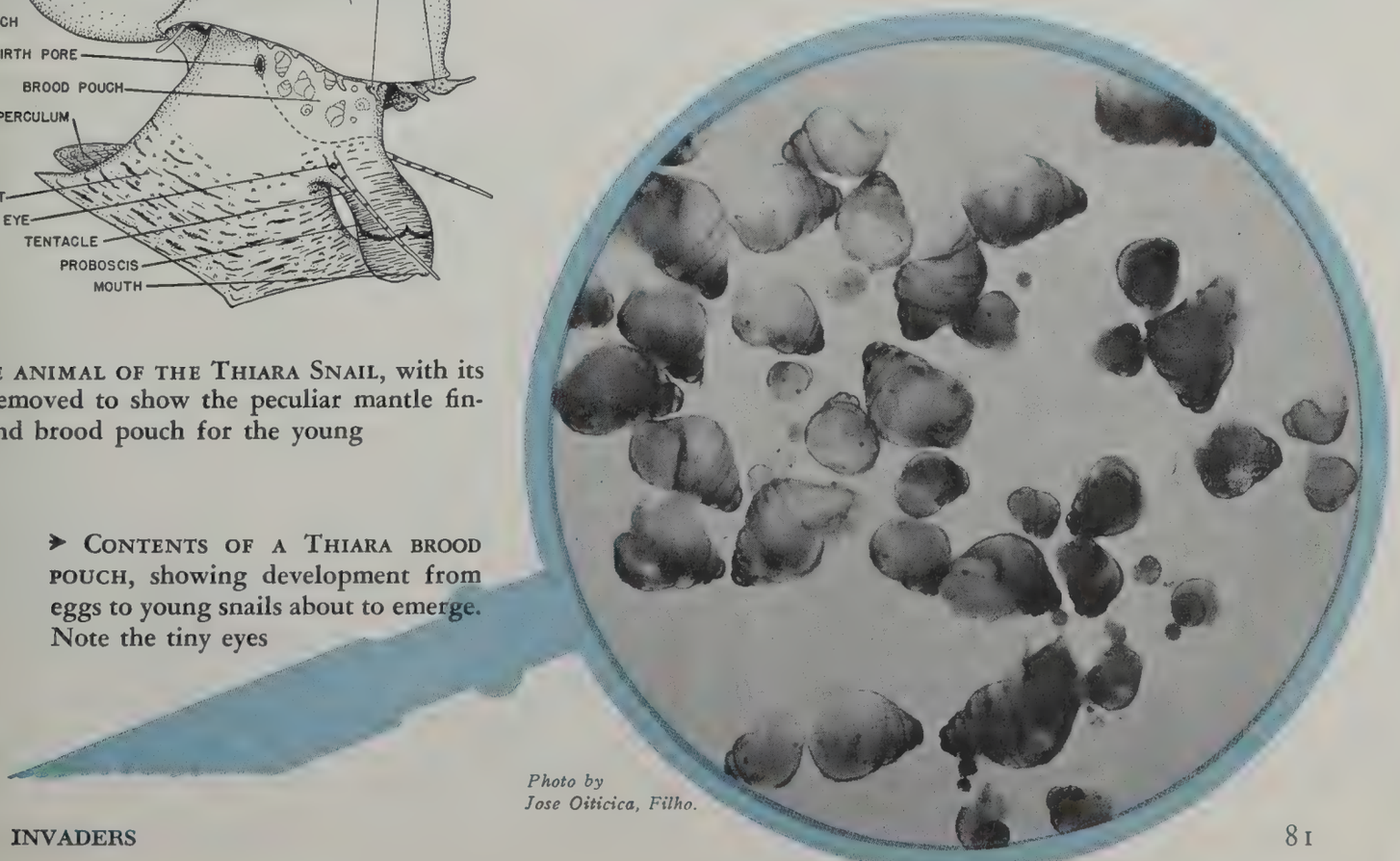
* See "March of the Giant African Snail," NATURAL HISTORY for February, 1949, p. 68.



➤ THE ANIMAL OF THE THIARA SNAIL, with its shell removed to show the peculiar mantle fingers and brood pouch for the young

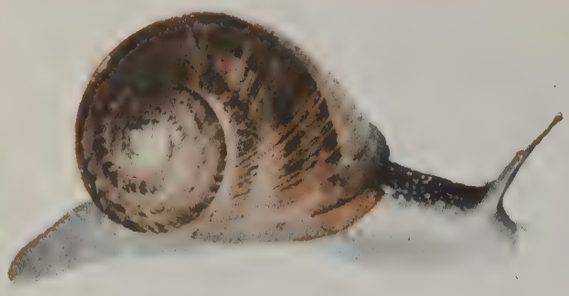
Smithsonian photo

➤ THE HALF-INCH LONG THIARA SNAILS recently introduced into Florida are potential carriers of the human lung-fluke disease. They resemble our local species but may be recognized by the unusual characteristics of the animal, depicted at left



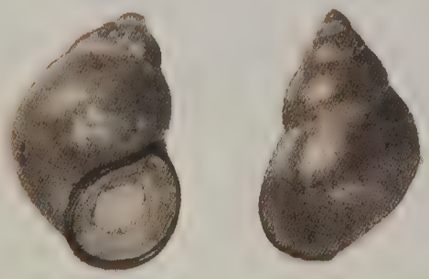
➤ CONTENTS OF A THIARA BROOD POUCH, showing development from eggs to young snails about to emerge. Note the tiny eyes

Photo by Jose Oiticica, Filho.



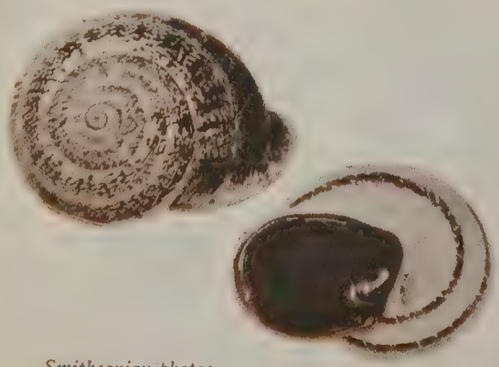
FRENCH EDIBLE SNAIL (*Helix aspersa* Müller)

THIS "ESCARGOT" or Brown Garden Snail has become a serious garden pest in California since its first introduction in 1856. These snails are still imported from France and Italy to eastern cities, where they are eaten by many people. Color: light yellowish-brown with dark brown bands and specklings. Size of shell: 1 to 1½ inches. Original home: Western Europe.



FAUCET SNAIL (*Bulimus tentaculatus* Linné)

SEVENTY YEARS AGO this small fresh-water snail made its American debut. Within a few years it spread over much of the northeastern section of the United States. It is not a human disease carrier but has been responsible for clogging the waterworks of several cities. Color: drab greenish-brown to dark tan. Size of shell: ¼ inch. Original home: Northern Europe



SPANISH EDIBLE SNAIL (*Otala lactea* Müller)

THIS LAND SNAIL is frequently imported from North Africa and Spain for food purposes. It has escaped and established itself in several places in southeastern United States, but it is not a very destructive species. Color: whitish with brown bands and gray specklings. Lip: black-brown. Size of shell: 1 inch. Original home: Mediterranean countries

Smithsonian photos

Fortunately, as an American your chances of catching this disease are extremely remote. The parasitic worm is not in this country as yet; nor are we certain that our species of fresh-water crayfish could serve as intermediate hosts. Nor can we say that many Americans are in the habit of eating raw river crayfish! Lithia Spring may be swarming with Thiarid snails, but it is still a perfectly safe and charming place to swim.

How did this oriental snail find its way to Florida? Back in 1936, a California aquarium dealer had been importing exotic water plants and tropical fish. In one of his shipments from some Pacific or East Indian island, one or two of these snails arrived. At first they were unnoticed, but later they were obvious by virtue of their powers of reproduction. A visiting dealer from Tampa, Florida, was struck by the oddity of these snails. Their elongated, reddish-brown shells are not unattractive, and the snail is able to produce tiny young alive. Within a year or so, this species was being sold as the "Philippine Horn of Plenty." The Tampa dealer occasionally refurbished his tanks with local aquatic plants, and during a foray to Lithia Spring, a wooden collecting tub was cleaned at the edge of the spring. One oriental snail was enough. Within a few years, a budding colony had increased to a density of 400 individuals per square foot.

A study was made of the life history of *Thiara granifera* to determine its capabilities of spreading to other parts of the country. The exact mode of reproduction is still a mystery. To date, we have not found sperm; in fact, we have found no males. Either the snail reproduces without the intervention of the male, or there is a fleeting period of maleness in the early life of the individual. Both types of reproduction (parthenogenesis and protandric hermaphroditism) are known in species of this general type of snail. We do know, however, that developing eggs are stored in a brood-pouch just under the skin on the back of the mother. A molluscan kangeroo! The tiny, red-shelled young may be seen through the skin of its parent, crawling about this protective chamber. The young snails emerge, on the average of one every day, through

a small birth pore located on the right side of the mother's body.

It was discovered that this snail perishes in water temperatures below 70 degrees F. The spring water at Lithia is always about 75 degrees F., but the near-by river into which it flows is well below this temperature and serves as a barrier against further spread of the snail. Birds or man may introduce it to other warm springs, however. In Tampa, the overflow from the commercial tanks supports this species during the warm summer months, but winter chills wipe out these few scouts each year. It is reasonable to expect that this snail will limit its Americanization to a few isolated cliques in remote warm springs of the Southeast.

In all, we may breathe a sigh of relief with regard to this latest invader. It does not constitute an immediate menace to our public health. However, other snails, such as *Australorbis*, which would make an attractive aquarium pet, and the Japanese "schisto snail," *Oncomelania*, are far more dangerous. The disease they carry, the blood fluke, is much more serious and is acquired by merely bathing in infected waters or dipping one's hands in the fish bowl. The river systems of the Midwest would probably be ideal colonization grounds for several of these snails. Fortunately, the sanitary habits of Americans reduce the possibility of widespread establishment of the blood fluke, although this disease might be perpetuated by dogs and wild animals which can serve as reservoir hosts.

Four, and possibly more, freshwater introductions have occurred in the United States, although the origins of many remain obscure. Most aquarium fanciers are familiar with the live-bearing Japanese snail (*Viviparus malleatus* Reeve), but few realize that this greenish-brown, golfball-sized mollusk has established itself in several American localities. They were first imported alive from Japan to the Chinese markets of San Francisco in 1891 for food purposes. By 1900, they were firmly entrenched throughout the artesian belt from San José to San Francisco. In the East, they were first discovered by

WHITE GARDEN SNAIL (*Theba pisana* Müller)

SO FAR, this species is found only in Southern California, where it was first noticed in June, 1914. It multiplies rapidly and becomes a nuisance by partially defoliating trees of citrus fruit, although no serious damage seems to have been done. Color: ivory-white with broken bands of light brown. Size of shell: ½ inch. Original home: Mediterranean countries

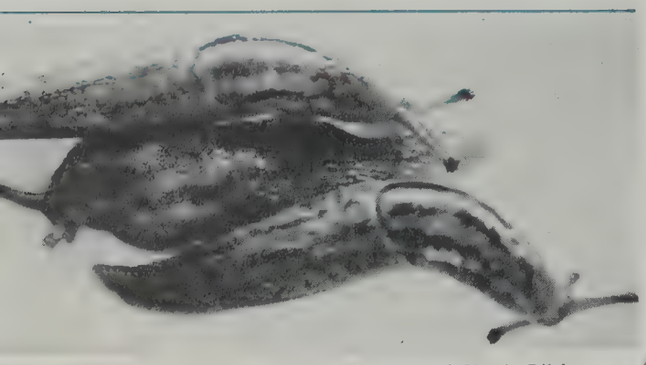
SPOTTED GARDEN SLUG (*Limax maximus* Linné)

THIS IS ONE of the dozen European species of slugs that have established themselves in many parts of the United States. The Spotted Garden Slug does great damage at night to gardens and mushroom beds. During the day, it hides in open cellars and under boards. Color: yellowish-gray with black spots. Length when extended: 3 to 5 inches. Original home: Europe

BANDED WOOD SNAIL (*Cepaea nemoralis* Linné)

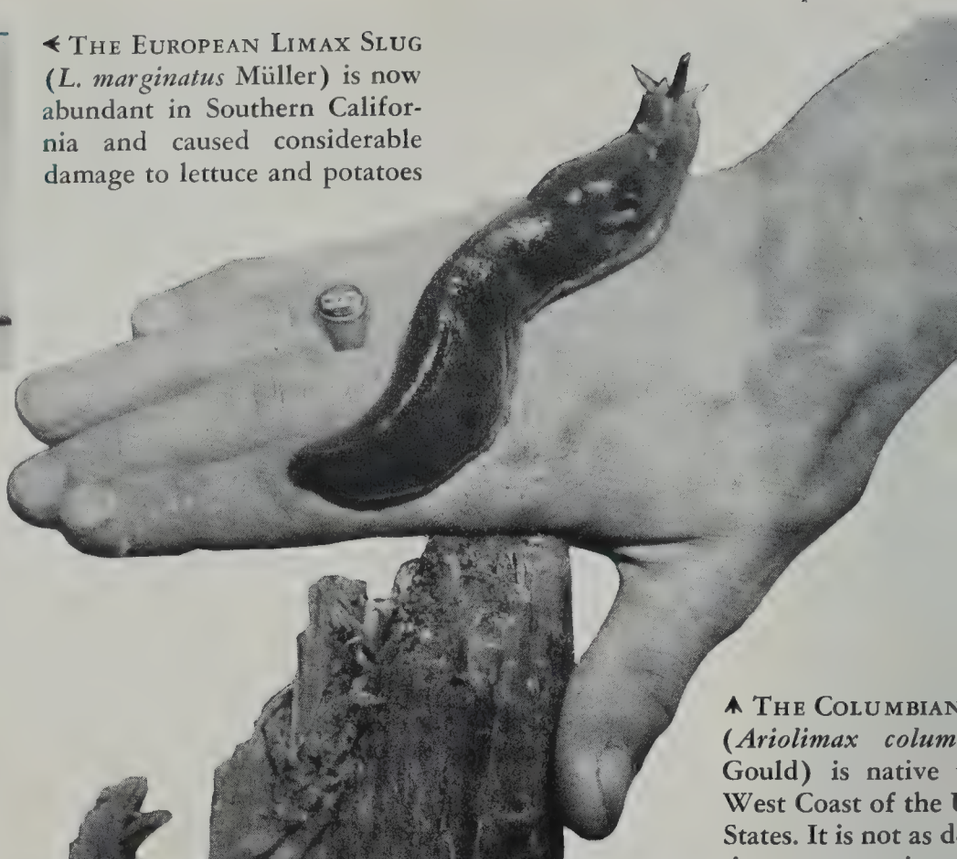
EARLY SETTLERS may possibly have introduced this pretty land snail many years ago. Colonies still thrive in a number of eastern towns. Apparently it does little, if any, damage to gardens. Color: yellow to pinkish-tan with chestnut to black-brown bands. Size of shell: ¾ inch. Original home: Northern Europe

mithsonian photos



Courtesy of H. A. Pilsbry

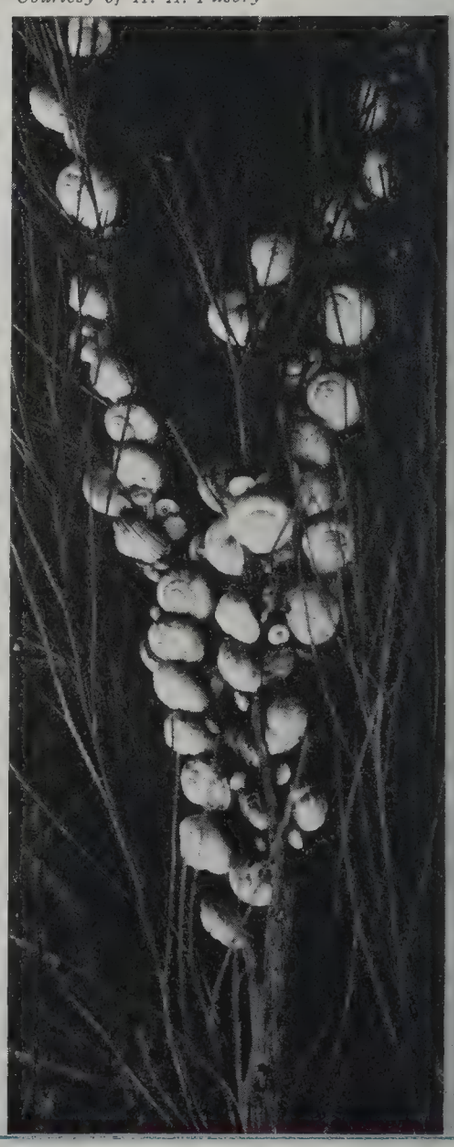
THE EUROPEAN LIMAX SLUG (*L. marginatus* Müller) is now abundant in Southern California and caused considerable damage to lettuce and potatoes



Smithsonian photo

THE COLUMBIAN (*Ariolimax colum* Gould) is native West Coast of the U States. It is not as d tive as some intro European species

Courtesy of H. A. Pilsbry



Dr. William J. Clench, Harvard's mollusk expert, in April of 1914, in the Muddy River of Boston's Fenway. I have collected many beautiful specimens there as late as 1942. A colony may still survive in Lake Quinsigamond, near Worcester, Massachusetts, where it was first reported in September, 1917. This "escape" has also been found in Fairmount Park, Philadelphia (1925), St. Petersburg, Florida, and near Niagara Falls, N. Y. (1942).

"Among those also present" is a fresh-water corbicula clam from Japan, which is doing well in the Columbia River, Washington, and a small valvata snail, which is now widespread throughout the Great Lakes region. A small, left-handed pond snail, *Physa acuta* Draparnaud, has occasionally journeyed from Europe and temporarily set up egg-laying in eastern cities.

Even some of our common seashells are not native to the United States. Every visitor to the rock-bound coast of New England who has observed the denizens of the tidepools is familiar with the common periwinkle, *Littorina littorea* Linné. Its "Plymouth Rock" is unknown, although it was first found at Pictou, Nova Scotia, in 1840. From Nova Scotia it spread rapidly southward, its pelagic early stages being carried in the plankton by the Labrador Current. By 1892, it had reached its southern limits at Atlantic City, New Jersey. In exchange for this European student, we returned (accidentally, of course) to England an American citizen, the dreaded oyster drill, which annually kills a million dollars worth of oysters. This was hardly sporting on our part, but while we were making apologies, an even larger and more destructive drill, *Ocinebra japonica* Dunker, was brought in from Japan and has established itself in several bays of Puget Sound. Such is the price to pay when introducing "bigger and better" oysters from foreign lands. Pests always come with them.

Land snails, however, stand foremost as successful immigrants, and Californians who take pride in their beautiful gardens can surely wax eloquent on the European brown garden snail, *Helix aspersa* Müller. A great deal of expense, both private and public, has been incurred in the battle against this vegetarian. This species is probably the most widely traveled of his clan, since it is one of the elite "escargots" or edible snails of France. Wherever the "fleur-de-lis" has been unfurled, this species has been among the wit-

THE WHITE GARDEN SNAIL (*Theba pisana* Müller) is from the Mediterranean countries. It has caused partial defoliation on California citrus trees and other plants

nesses. *Helix aspersa* first reached the United States at Portland, Maine, in 1839 and was last seen there in 1936. Its most successful landing was made in 1856, when it was introduced for food purposes at San José, California. It arrived in New Orleans from Spain and in Massachusetts from Ireland.

Several other land snails have become permanent residents, some quite a nuisance, such as the white garden snail, *Theba pisana* Müller, which partially defoliates citrus trees. The distribution of the various species follows the temperature and humidity gradients that best suit them. The Spanish edible snail, *Otala lactea* Müller, which is accustomed to the warm, dry areas of the Mediterranean, has had ample opportunity to establish itself from Montreal south, but it has gained a foothold only in such southerly localities as Cockspur Island (Georgia), Houston (Texas), St. Petersburg (Florida), and Los Angeles. Should the giant African snail make its entry into the United States, it is my opinion, which may differ from that of other malacologists, that the southern third of Florida is the only suitable area for its survival for any great length of time. Recent accounts of the invasion possibilities of this giant border on the hysterical, although I do not wish to minimize the importance of keeping a watchful eye on snail invaders.

The unattractive slugs of Europe have done well for themselves in America. Eleven or more species are now firmly entrenched on our soil, and a few of them are found in nearly every state in the Union. Public enemy numbers 1, 2, and 3 are the spotted garden slug, *Limax maximus* Linné, the true garden slug, *Deroceras*, and the tawny garden slug, *Limax flavus* Linné. These European colonists retain their gregarious habits and in certain local areas are able to build up their numbers to very destructive proportions within a relatively short time. The American species, on the other hand, are less socialized and are, for the most part, solitary in habit and much less destructive.

Once here, foreign snails have many opportunities for further dispersal. Inspection of the bases of potted palms and other plants in hotel lobbies will often reveal such tiny aliens as *Subulina* and *Lamellaxis*. Transplantings, market crops, lumber that has been stored in seaboard cities, water cress grown in the south and shipped north each season—these and dozens of other transportation activities help spread molluscan pests.

Despite the iron-clad laws now in existence to keep out disease-carrying snails and the fine-toothed combing given agricultural shipments from abroad, it is perfectly natural that a few molluscan Dillingers are going to dodge the long arm of the quarantine laws. Our best protection is to continue our vigilance at our borders, which at present is as efficient as is humanly possible, step up our research on snails and their control, and familiarize agriculturists and aquarium dealers with the snail problem through the medium of popular articles.

Saving Your Garden From Snails

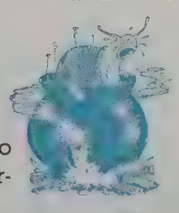
DESTROY 'EM!

The vast majority of species of snails stay in the woods and mind their own business, but not infrequently a row of garden lettuce or celery falls prey to hungry immigrant snails or slugs. One of the most successful poisoned baits consists of one ounce of metaldehyde to three pounds of wheat bran or "dry cereal," slightly moistened and scattered over the infested area. If small children or animals have access to your garden, scatter it thinly and not in large lumps or balls, since metaldehyde is mildly poisonous to warm-blooded animals.

Eliminate the snail's favorite haunts such as piles of old boards, bricks and stones, and dense, low-growing vegetation. Keep spaces beneath porches dry, and seal up chinks in basement walls. Hand-picking at night with a flashlight also helps.

Write to the Superintendent of Documents, Washington 25, D. C., for "Land Slugs and Snails and Their Control," Farmers' Bulletin No. 1895, by W. H. White and A. C. Davis. Price, five cents.

EAT 'EM!



The thought of eating snails is enough to break the courage of the hungriest American; but in Europe, "escargots" are eaten by the million each year, and in France snails are a national delicacy. Any snail is safe to eat if fresh and cooked. The secret of success with snails is in their preparation for the table.

First the snails are boiled in the shell for five minutes, after which they are removed, cleaned of the softer parts, and then reboiled for two hours. Leave whole or mince. Make a paste of butter, a considerable quantity of good olive oil, chopped parsley to taste, and a small quantity of minced eschalot or small onions. Thoroughly clean the empty shells and then stuff with snail meat, closing the aperture with a plug of the butter paste. In this condition they can be kept for some time in the refrigerator until ready for cooking. Simply heat them for about ten minutes over a hot fire, which literally broils the meat in the butter paste. Serve six to eight shells to a person; garnish plate with greens or salted crackers. Believe it or not, these snails taste very much like broiled oysters.

Other intriguing recipes, methods of farming snails, preparation for market, and other interesting facts are found in "Edible Snails" by E. W. Rust, Department of Agriculture Yearbook for 1914, Separate No. 653.

THE KIWI—

New Zealand's Flightless Oddity

Nature's unbelievable Believe-It-Or-Not, the kiwi—most unbirdlike of living birds and a twentieth-century anachronism. Even scientists insisted, "There ain't no such creature"—only to find it more fantastic than they had imagined

By VION *and* BERNARD SCHRAM

AT a crucial point in the Pacific war, supplies for the New Zealand troops stationed on New Caledonia failed to arrive on schedule. Familiar with military mix-ups, the supply sergeant began a canvass of other allied depots.

He inquired at the American base, "Are the Kiwi supplies here?"

The bewildered Yank in charge scratched his head and asked, "*Whose* supplies?"

Then, after a moment's thought, enlightenment dawned.

"Oh, you mean those boxes with the picture of a long-nosed, flat-bottomed duck marked K-one-W-one?"

The "flat-bottomed duck marked K-one-W-one" was none other than New Zealand's national emblem, a creature almost as out-of-date in modern times as a dinosaur, and the exclusive pride and joy of New Zealand, the only place in the world where kiwis are found.

Even ornithologists label the kiwi "the queerest and most unbirdlike of living birds." It resembles almost everything but what it actually is. Unable to fly, the kiwi's naked and useless wings are concealed beneath thick, hairlike feathers, so that its body looks more like a hedgehog's than a bird's. Its long beak, with a tuft of catlike whiskers at the base, gives its head the appearance of an anteater's. At first glance you might even think the

◄ THE KIWI RESEMBLES everything but what it actually is. Its wings, naked and useless, are concealed beneath its thick, hairlike feathers

Schram photo

NATIONAL EMBLEM of New Zealand, awkward kiwi graces a Government ıp. New Zealand is the only place in world where the bird is found

skin was a mammal's rather than a bird's. It is tough and leathery enough to be made into gloves and moccasins.

Very few foreigners and not so very many New Zealanders have seen a kiwi. Because of its timid love of darkness and its habit of digging rabbit-style burrows for daylight nesting, the kiwi was called "the hidden bird" by the Maoris, who thought it was under the special protection of Tane, god of the forest. However, this did not prevent these Polynesian hunters from tracking down kiwis for food and for their feathers, from which cloaks were made. Some of these early Maori cloaks, woven from native flax and kiwi feathers, are still in good condition though they were made as long as 200 years ago—a tribute to the durability of the kiwi's hairlike plumage.

The Maoris named the bird kiwi in imitation of its cry—a shrill whistle that sounds like *keeeee-wheee.*

Before the advent of the white man in New Zealand, kiwis abounded, despite large numbers slain by the Maoris. Fortunately, from a kiwi's point of view, New Zealand had no native mammals or reptiles to prey upon it, so that it was as safe from attack on the ground as in the air. Thus it was able to survive as a curious, earthbound bird, with vestigal wings measuring hardly two inches in length.

The downfall of the kiwi resulted from the nostalgia of English pioneers who longed for their familiar sports. Soon after establishing themselves in New Zealand, the settlers introduced all manner of foreign birds and animals to provide themselves with good hunting quarry. But they made one grave mistake: they loosed English rabbits and hares upon the countryside. Living up to their reputation for fecundity, the rodents soon multiplied until they became pests, threatening farm crops and ruining gardens. So the settlers promptly brought in stoats and ferrets to control them. This step also proved a boomerang.

The weasels quickly discovered that the native New Zealand birds, made unwary by centuries of life without ground enemies, were easier prey than the rabbits. The kiwi, which had the added disadvantage of being unable to fly, was almost entirely at the mercy of the imported killers. In short order, the kiwis' numbers were so reduced that New Zealand bird lovers feared they were doomed to extinction.

Yet another menace came from an unexpected direction. In their enthusiasm for sports, the New Zealand pioneers introduced American and European trout into their streams and lakes. In their avid experimentation in quest of artificial flies with trout appeal, they decided, with the inexplicable logic of the fisherman, that the drab brown and gray feathers of the kiwi made lures irresistible to the fish. Consequently, they scoured the countryside with dogs and guns, slaughtering hundreds of kiwis for their plumage.

As a result of these onslaughts

National Publicity Studios, Wellington

▲ TWO KIWIS: a New Zealand serviceman and his namesake. Somehow the country's armed forces were named "Kiwis," and the label stuck. Only airforcemen resented being named after a flightless bird

from all directions, kiwis became a curiosity instead of a commonplace bird in New Zealand.

By 1908, the kiwi had become so rare that a law was passed making it illegal for anyone to "take or kill" a kiwi without special government authorization. The law was weak and subject to widespread violation, so that in 1921 a new act was passed, which proclaimed the kiwi an "absolutely protected bird" and made it illegal for anyone to possess stuffed specimens, feathers, eggs, or Maori handicraft objects made with kiwi feathers, without permission from the Minister of Internal Affairs. The law also prohibited, on penalty of a $100 fine, the making of trout flies from kiwi feathers. A ban on exportation of the birds has been in effect since the 1908 law.

These laws, rigidly enforced by New Zealand's wildlife rangers, have helped to check the decline of the kiwi population, although the stoats and ferrets continue their raids. Conservation enforcement is difficult in any land. Dogs destroy large numbers, and vigilance for the welfare of the kiwi will continue to be necessary.

From the initial word of its existence brought to Europe by early nineteenth century explorers, the kiwi has been the object of curiosity and incredulity. Zoologists expressed frank disbelief in the existence of this "ball of fur on two sticks." Even when Captain Barclay of the ship "Providence" brought a kiwi skin back to England in 1812, scientists imitated the farmer who, seeing a giraffe for the first time, stoutly maintained, "There ain't no such animal." Later, when a live kiwi was presented to the London Zoological Garden, they were forced to admit that the fantastic bird actually existed.

Kiwis then became the rage among bird fanciers. Lord Rothschild collected a number of specimens for his private aviary. The Emperor of Austria and Hungary secured a pair for his personal zoo. Collectors and zoological gardens all over the world vied in procuring the weird birds.

All had the same experience. The nocturnal birds lived for only a short time in captivity, and none produced young, even though one obliging kiwi in London sat on an infertile egg for 114 days before admitting defeat.

But the kiwi egg proved as great a curiosity as the ungainly bird itself. One species of kiwi weighs only five or six pounds at full maturity yet lays an egg weighing a pound or more—almost a quarter the size of the bird itself. So dis-

Photos courtesy New Zealand Legation

▲ KIWIS BURROWING for worms. By the age of three months, the baby kiwi consumes one and a half pounds of worms a day—or 800 of them

◀ THE ELONGATED BEAK comprises nearly a third of the kiwi's total length. So acute is the bird's sense of smell that it can locate worms underground before driving its bill into the earth

proportionately large is the egg that just before it is laid, the overladen hen staggers under the weight like a drunken sailor in a gale. Even the ostrich, which may weigh as much as 250 pounds, lays eggs that are only slightly larger; and the domestic turkey, a much bigger fowl, lays an egg less than a third the size of the kiwi's.

It was only three years ago that the first kiwi chick was hatched in captivity, enabling scientists to report that the kiwi male is easily the most henpecked husband in the world.

The credit for this achievement goes to F. D. Robson, Curator of the Hawkes Bay Acclimatization Society's game farm near Napier, New Zealand. An expert in raising pheasants and trout for release in the Hawkes Bay area, Robson acquired—illegally, it may be added—his first kiwi some seventeen years ago. It was a fully grown, five-year-old cock that had been captured by pig hunters, who kept it secretly until it escaped. The frightened fugitive bird was found huddled in a Napier factory coal bin and was turned over to Robson. Curious to learn the habits of the rare creature, Robson ignored the law requiring him to report possession of the bird to the wildlife officials.

Robson kept his kiwi for six years, until he was fortunate enough to acquire a badly injured one-month-old chick that had been caught in a bush fire. He carefully nursed the chick, a hen, for five years until she reached maturity. She then started on an egg-laying spree that refuted all authorities who had previously claimed the kiwi could lay but one of its monumental eggs per year. Within a four-month period, Robson's hen laid four eggs – all of which, however, proved to be infertile.

By this time, word of his under-the-counter kiwis reached the ears of the authorities. Considerable controversy arose, with the influential Hawkes Bay Acclimatization Society taking Robson's part. At length, a special cabinet meeting handed down a decision that Robson could keep his pets in order to observe their breeding habits, on condition that he provide the Department of Internal Affairs with semiannual reports on his findings.

On September 19, 1945, Robson announced an event that held as much interest for New Zealanders as the Dionne quintuplets for the Canadians: the first kiwi was hatched in captivity. Unlike Papa Dionne, whose role had been all but ignored, Papa Kiwi came in for the lion's share of the credit.

For weeks, New Zealand newspapers printed almost daily reports on the progress of the setting, and editorials featured the brow-beaten male kiwi as the most notable victim of female emancipation.

As Robson describes the situation, "After Mama Kiwi laid the huge egg, she lost all interest. It was Papa Kiwi who made the nest and sat on the egg for 80 days until it was hatched. Sometimes he wouldn't leave the nest for a week, going without food, and at the end of the ordeal, he had lost two pounds in weight. He didn't look much bigger than the chick when it was hatched.

"While he was on the egg, he was so maternal he'd attack anyone who approached him, and the only time the hen came close was just before the egg was hatched. One day she came to the box in which the male was nesting and rapped on the outside with her beak. He replied by tapping on the box from inside. They must have been using some kind of Morse code, because she went away satisfied and took no further notice of the incubation."

Insult was added to injury for male vanity when the kiwi hen laid a second egg only 26 days after the first, just when the poor male had gotten well settled on it. As a consequence, the harassed husband had to extend his vigil to 100 days, at the end of which not one but two chicks had been hatched. Last season he had an even worse ordeal. Five eggs were laid over a period of six months, and the male bird sat continuously for 185 days.

News of the new arrivals traveled round the world among bird circles. In America the tale of the kiwi chicks and the birds' gigantic eggs caught the eye of an enterprising poultry farmer. Without delay he wrote to Robson requesting all details, with an eye to crossing kiwis with his hens to produce larger eggs.

"When he heard that kiwis only lay a couple of eggs a year, he lost interest," Robson reports.

Since then Robson has been assailed with bids for the kiwis, which are really wards of the state in his custody. One American bird fancier has offered $1200 for a fertile kiwi egg and promised to arrange for its delivery to the States by air. More recently, an American tourist, a little the worse for a farewell shipboard party, landed in Auckland and demanded to know, "Where can I buy one of these kiwi birds?" Undismayed at the news that kiwis were not for sale anywhere, he lurched down the street, proclaiming, "I'd give $50 for one of these d————d birds."

All such proposals, including a patriotic suggestion to present a pair of kiwis to Winston Churchill in appreciation for his war services, have been politely rejected.

Wildlife officials point out, "The kiwi is not a bird that adapts itself to exhibition. It is a night bird, accustomed to sleeping during the daytime, just when people would want to see it. Moreover, its food demands are such that it does not appear to thrive on a strange diet. Therefore, no kiwis are being released for zoos."

In reality, the Wellington Zoo has two kiwis on a basis of dubious legality. Residents of the zoo for many years, the kiwis roam the bush adjacent to the menagerie area. They are caught on rare occasions for display to important visitors and were penned for some months for the benefit of American troops stationed in New Zealand. When queried about the kiwis, the curator innocently lifts his eyebrows and protests, "We have no kiwis in captivity. There may be wild ones on the grounds, but we can't be responsible for them."

However, the kiwis' presence is all too well known to the zoo gar-

dener. The birds have taken a fancy to his rose garden, in the beds of which they probe nightly in quest of worms. Lately, they have developed an unaccountable taste for rosebush shoots and, much to the gardener's dismay, have completely stripped the plot of young plants.

Robson is a whole-hearted sympathizer in regard to the kiwis' "food demands." The baby kiwis at the game farm are born weighing only six to ten ounces. During the first four days of their life, they are too weak to support themselves on their own legs, and Papa Kiwi, who by this time has had enough trouble with them, doesn't bother to feed them. On the sixth day, the chicks stalk out on their own and start boring into the ground with their beaks in search of worms. For the first two weeks of their life, they lose weight. Then they commence to gain, and at the end of three months they each consume one and a half pounds of worms a day.

The daily worm diet for the chicks, with slightly less for the adults, keeps Robson hard at work. Although he stumbled across the expedient of "planting worms" by burying bits of meat from which maggots hatch, he still spends many hours engaged in worm digging.

"Do you know how many worms it takes to make a pound and a half?" he asks ruefully. "It takes 800."

His kiwi brood now numbers six —the original pair, three of their offspring, and "Pegleg Pete."

"Pegleg Pete" is a recent acquisition. Some months ago, he was caught in a possum trap, which broke his leg. The trapper turned the injured kiwi over to the conservator of game, who was forced to amputate the broken leg in order to save the bird's life. Then it was sent to Robson.

Robson has ingeniously devised a pegleg for the bird by whittling a hollow joint of bamboo to fit the stump and making it fast with a piece of rubber tubing. Today "Pete" hops around so agilely on his pegleg that he frequently eludes Robson when the curator seeks to catch him in the large enclosure housing the kiwis. Consequently, Robson sometimes has to resort to trickery. Sighting the bird, Robson will make a scratching noise on the ground to startle him. When the myopic kiwi charges blindly forward, Robson jumps to one side. The bird butts into the wire fence, and the curator captures him before he recovers his balance.

Robson has his own theory about why kiwis lost the power of flight. He bases it on the fact that the kiwi has very poor eyesight—with a range of vision limited to about two feet in daylight and six feet at night. He states that a bird so blind could never fly in the forest without killing itself.

Despite its groundling status, the kiwi is a well-qualified sprinter. It easily outdistances an unmounted man and can hold its own against dogs. Most kiwis that are captured by dogs are surprised during daylight when they are asleep in their burrows.

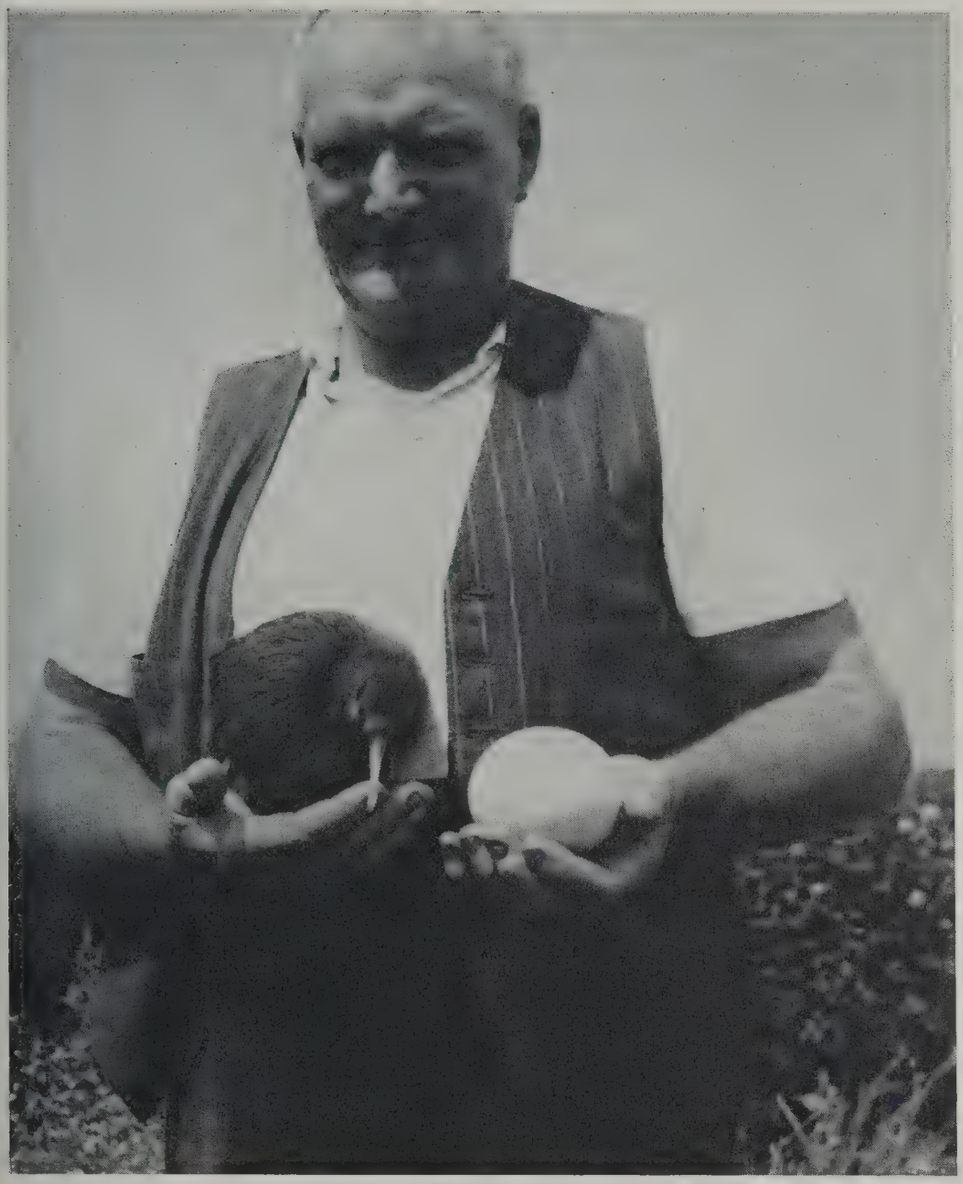
Although a subject for zoological study for more than a century, the kiwi has been seen in a live state by relatively few ornithologists. Those who have seen the bird at close quarters find the kiwi so ludicrous in appearance that they are moved to attempts at whimsy, even in scientific writings.

The noted New Zealand naturalists F. W. Hutton and James Drummond felt called upon to assert: "Not a bone in its frame or a muscle on its ungainly body, and hardly a feather of its hair-like plumage has escaped minute and elaborate description. Its innermost private life has been invaded; and its habits, its clumsy gait, its wretchedly defenseless condition, its family failings, its deformities and malformations have been made public."

Like a Walt Disney character come to life, the kiwi literally sniffs its way through life, depending on its keen sense of smell to guide it, in compensation for its pitifully weak eyes. To facilitate this, the nostrils are in the very tip of the elongated beak, which comprises nearly one-third of the bird's total length. With audible snorts, the kiwi wobbles ungracefully along, its beak inquisitively probing the ground at each step. Its sense of smell is so acute that it literally smells worms underground before driving its bill into the earth.

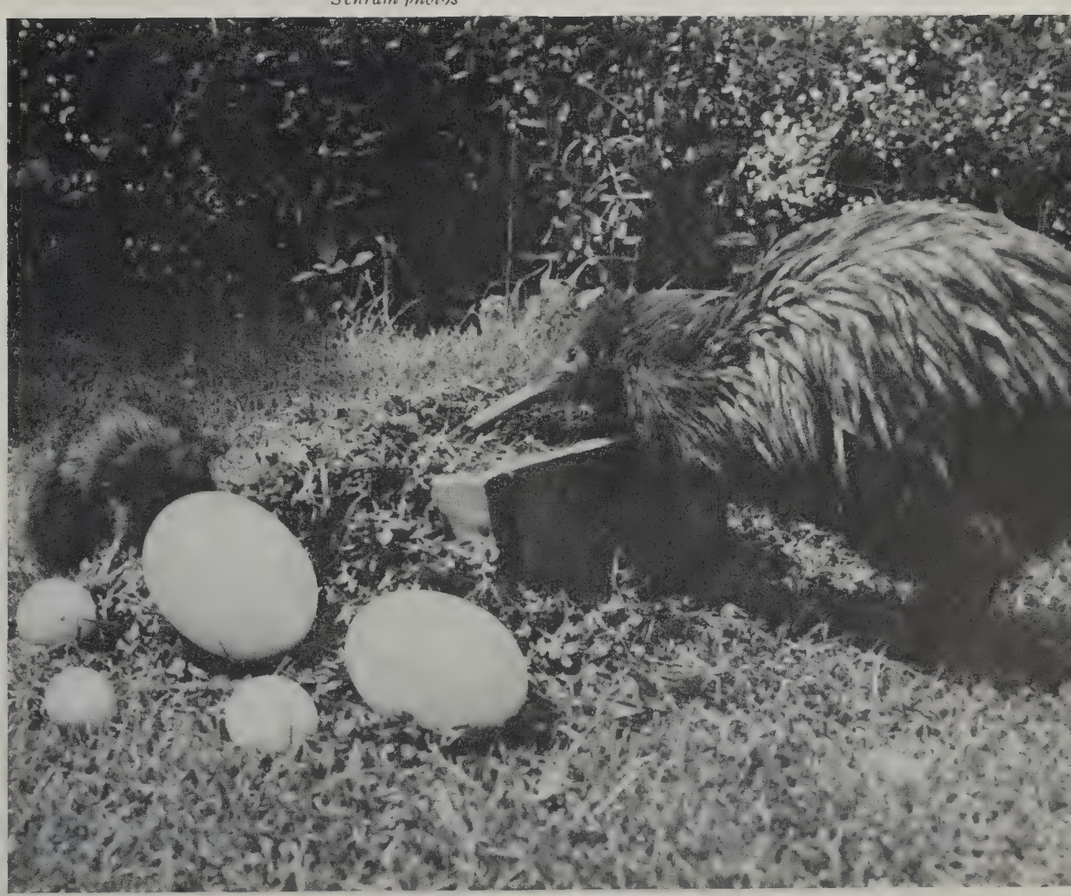
▼ THE MOST HENPECKED HUSBAND in the world: Papa Kiwi incubating an egg. After the egg is laid, the female loses interest, and the male is saddled with all responsibility until the hatching

Courtesy New Zealand Legation



▲ THE GIGANTIC EGG is out of all proportion to the kiwi—almost a quarter the size of the bird itself

Schram photos



▼ STUDY IN CONTRASTS: hen's eggs and kiwi's. Even the domestic turkey, a much bigger fowl, lays an egg less than a third the size of the kiwi's

The kiwi runs like a novice tightrope walker, placing each foot exactly before the other in a straight line, while its tailless rear sways wildly from side to side in a feathery burlesque of the cancan.

Had it not been for the war, popular interest in the kiwi would probably have remained confined to New Zealand. But before the war ended, every newspaper reader and serviceman knew the gallant New Zealand fighting forces as Kiwis.

There are numerous theories as to how the name Kiwi came to be generally applied to the New Zealanders fighting all over the world. One story says that the term was first applied to them by their Australian neighbors. Another attributes it to the popularity of an English shoe polish using the kiwi as a trademark and brand name. This version has it that Arab servants employed in polishing New Zealand officers' shoes in North Africa began calling them all "Mr. Kiwi."

Regardless of origin, the term quickly gained acceptance and was applied to all New Zealand forces on land, sea, and in the air—much to the disgust of airforcemen, who resented being named after a flightless bird. Soon American and English airmen were calling their own ground crews Kiwis because they did not fly.

When the Pacific battle started, the term was so popular that the New Zealand Third Division on duty against Japan boasted the kiwi as an official insigne. They published a service newspaper entitled "The Kiwi News" and received all their mail and supplies with the kiwi stenciled on the containers. German propaganda leaflets dropped for New Zealand troops

in Africa addressed them familiarly as Kiwis and featured illustrations of the national bird. Military cartoonists habitually used the kiwi to symbolize New Zealand forces.

When New Zealand troops retreated from Greece after a valiant but futile holding operation, they sadly remarked, "We kiwis can't fly, but, by God, we can run."

Today the kiwi is prominent in every aspect of New Zealand life. Its awkward figure graces stamps, bank notes, and coins. Business firms using its name range from the Kiwi Dental Repairs Company to the Kiwi Cake Kitchen. It has been adopted as the distinguishing mark of the New Zealand Manufacturers Federation and appears on all products made by the organization's members.

At least one noteworthy New Zealander, however, takes issue with all this kiwi-consciousness. He is Arthur P. Harper, President of the Forest and Bird Protection Society of New Zealand.

"America has her eagle that stands for freedom," he says. "Britain has the bulldog to signify tenacity. We've adopted a beastly bird that isn't even good to eat."

Harper, an eighty-four-year-old New Zealand pioneer, ought to know. Credited with opening up large regions of New Zealand through his exploration in the last century, Harper has spent most of his life in the native bush along with the kiwis. In the old days, he ate kiwi on many occasions.

"It tastes terrible," he reports. "Like an old piece of pork boiled in second-hand coffee."

CANYON UTOPIA *Continued from page 79*

able land will devote several acres to raising the feed needed for the ponies. Bert Jones, our twenty-one-year-old guide, boasted that he and his father owned a couple of hundred head of stock, most of which ran wild on the mesa above and were rounded up only when tourist demands made additional stock necessary.

Visitors, who have been coming to Havasu in increasing numbers in the last decade, provide a modest revenue for the Indians. These visitors require pack animals, saddle ponies, and guide service, all of which mean a small but steady income for the Indians. Since visitors are few as yet, the proceeds from this source are necessarily small, but they are a welcome addition to the villagers' meager income and explain their friendliness to outsiders. The Indians round out their income by taking occasional jobs on the plateau above. Most of the young men do seasonal chores for the National Park Service. They also engage in a little horse trading, do work on the roads, or fill a variety of simple jobs that earn an honest dollar. However, Havasu Canyon is home to them, and they always return in time for the planting and later for the harvesting.

Despite their sometimes pinched conditions, the Havasupai are a happy people. Their needs are few and simple. They have their own local law enforcement machinery, a school for their children, and a government agent who devotes his whole energy to supervising their welfare. Besides the white man's law as embodied in the subagent, the Havasupai have their own representation in the form of a local council. This body consists of seven members, including three hereditary chiefs who serve for life and four others members elected annually by popular vote. The council handles the minor affairs of the tribe and has jurisdiction over certain phases of the Indians' life — although every major proposal must have the approval of the Superintendent of the reservation.

The only local vice is gambling, and the whole adult population indulges. A closely-knit people like the Havasupai have little home life as it is understood by other races. Their pleasures are derived from gathering with the other members of the community. Around two every afternoon they begin to assemble at a clump of cottonwoods near the stream. Soon the whole village is there, squatting cross-legged in the shade. Here on blankets and sheepskins laid out on the ground, they begin the gambling, men and women smoking their hand-rolled cigarettes and noisily making their bets. A man may leave off work during the heat of the afternoon and sit in on a session of cards, returning to his fields when the heat has subsided.

They play a complicated game, in groups of seven, with each player holding ten cards. Though they gamble for small stakes, they play with great enthusiasm and good humor and gather up their winnings with the eagerness of laughing children scooping up marbles. The winnings go into groceries and clothing and jewelry and trappings for their horses. The village has a buying cooperative, and once a month the agent goes outside to Williams or Flagstaff and brings back the supplies. The people have a spirit of friendly co-operation, though they do not share their winnings.

Besides the daily gambling, the Havasupai have few diversions. They take part in the annual Powwow at Flagstaff, in which they always enter a few riders and generally make out well enough. They also have two or three ceremonial dances. These dances are not necessarily religious in nature. One festival celebrates the fruit harvest and is purely a social affair. The Havasupai are not outwardly pious, although like all Indians they are inherently religious and have their own version of the stories of the Flood and the Creation.

The Supai are not a picturesque people, as Indians go. They have few tribal traditions, few legends, and no native costume. The women dress in shapeless Mother Hubbards and generally go barefoot. The men, because of their contact with visitors, dress more picturesquely, wearing the traditional cowboy riding outfit of broad-brimmed Stetson, blue jeans, colorful shirt, and gay neckerchief. They belie the Indians' reputation for stolid silence by be-

ing a friendly and even talkative people. They are quick to smile and laugh, and greet strangers cordially. Even the women show a friendly attitude toward whites—something rare in Indian behavior.

Visitors are still a novelty to the simple villagers, who cannot understand what makes whites so inordinately curious. The old men question visitors eagerly concerning the outside world. The women, like women the world over, sit and gossip with the neighbors. Squatting on the bare ground, they mold the tortilla-like loaf of bread which is their chief item of food and which is fried over an open fire out-of-doors—where all cooking is done.

The pastoral seclusion of this desert utopia is in little danger of being interrupted by an immediate foreseeable circumstance. Since Havasu Canyon lies within a reservation, which in turn is embraced within a national park, the little settlement would appear to be doubly secure from the encroachments of all save those hardy adventurers who enjoy roughing it. While the village has sleeping accommodations for half a dozen, it has no provisions for serving meals. At the present time, visitors must bring their own food and bedding and be literally self-sustaining. Because of the limited accommodations, prospective visitors who prefer to sleep under a roof should write to the tourist-agent at Supai, Arizona, via Grand Canyon, in order to assure themselves of reservations.

Havasu Canyon is an outstanding scenic area. Below the village is the primitive region of rugged grandeur with its series of enchanting waterfalls, which are among the most beautiful on this continent. Only their isolated location has kept them from becoming a mecca for visitors. But the traveling public is catching on, and Havasu Canyon is due for a tourist boom. Faced with this happy prospect and with the innovations the Indian Service has in mind, the Supai of Havasu Canyon have little need to worry about the future of their canyon home. Under the watchful eye of the Indian and National Park services, they are likely to enjoy their present fortunate status—which is a combination of Eden, Utopia, and the happy hunting grounds—until the day the Supai Gods tumble from the canyon rim and crumble to dust in the sparkling depths of the Blue Water.

THOSE BAROTSE! *Continued from page 61*

through a stately mopane forest and saw lion tracks, and we knew the lions would not be there unless there were game. Then we came upon buffalo spoor and were confident that our food troubles soon would end.

By late afternoon we had passed no village, seen no signs of man, until we reached, before sundown, a large boma—a clearing surrounded by a reed fence. Surely this must be M'Lumba's, the large village we had been told we would find across the border. Surely we must, at last, be in Portuguese territory and no more than a few days' walk from Tete. In so large a village, too, we should be able to trade for grain to feed our hungry carriers.

A scowling, unfriendly headboy and his two wives greeted us. It was M'Lumba, and he and his women brought a fowl and a few eggs, for which I haggled while the men went hunting. A buffalo in camp would change the unfriendly atmosphere, so I turned away from the villagers and went about the business of making camp, although conscious that M'Lumba and his women hovered like vultures, waiting for further trading, and I knew that the problem of that evening's meal was not yet settled.

The hunters came in with a small waterbuck cow, which was no more than a tantalizing suggestion to 60 hungry boys. We brought out a few yards of calico, but M'Lumba saw our predicament and drove a hard bargain for very little grain. There were low mutters about the lack of food, the weight of the loads, the distance to Tete.

When it was dark, I picked up our last half sack of sugar, hoping that might tempt the surly M'Lumba.

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We had to keep the M'Curry Curry in a good humor and get the children through to the safety of the camp.

Shilling, brother of the Mudalla, stepped up and took the sugar sack. "You cannot sell that, Inkos," he said indignantly. "We are black boys. If we die it does not matter. You and the picannins must get through to Tete, and you must not sell your food. We can get along."

Those Barotse!

The campfire crackled, and it should have been a peaceful night, but it was not. M'Lumba said it was far to Chioco, the next village, and that there was no water on the way, which meant that there would be little game, if any.

Pocket, one of the M'Curry Curry, suddenly sailed over the fence into the boma, and Saiman and Mengeneera stormed through the gate in pursuit.

"This low-down cur of a M'Curry Curry is trying to run away!" exclaimed Mengeneera, stammering as he always did when in a rage, and he shook the boy whom he had tossed over the fence.

Holding Pocket in front of them, the 17 Barotse gathered to one side of the clearing, the 40 M'Curry Curry on the other. Then Pocket broke loose and made a dash for the gate, the rest of the pack on his heels. The M'Curry Curry were going home. It was mutiny.

The Barotse waded into the mutineers with knobkerries, spears, sticks, fists, stones, anything at hand. A seething black mass, licked with light from the fire, tumbled in a corner. Peter and Jonas were trying to choke one boy, holding him against the wall of a hut. There was no sound but the thump of stick against skull, the thud of a fall, heavy breathing, curses, grunts, and the gasps of 60 furiously battling men.

Outnumbered more than three to one, the Barotse were fighting for the right to dictate to the M'Curry Curry, and all our plans depended on the next few moments. Unless the carriers were beaten into going on, the only direction in which they would carry was toward Southern Rhodesia and home, or they might refuse to carry at all.

There was a sudden lull, and the mutineers crouched in a corner of the fence, the Barotse threatening them if they moved. Mafaeking stepped to the front of his "brothers" and held up his hand, spitting scornfully in the direction of the M'Curry Curry.

He drew himself to his full height, his coppery torso burnished by the firelight, and paused for attention. No one so much as coughed, and then he let his deep voice roll. "I, Mafaeking, Mafaeking of the Barotse, speak to you—baboons." Not a whisper stirred in the silence while he scored the M'Curry Curry for yellow deserters. Speaking for all Barotse, conquerors and men, he tongue-lashed the "baboons." He told them how men, like himself and his brothers, met crises and work to be done. He was arrogant with pride of race, his every gesture majestic. "You will go through to Tete." He delivered his ultimatum. "I, Mafaeking, hunter for Lewanika, king of the Barotse, tell you so. And the Barotse kill—so." He finished with a significant strangling gesture about his throat.

There was whispering in the corner, among the "baboons." Then Pocket, the first deserter, stood up.

"We have made a mistake, Inkos. We will go to Tete."

On the twentieth day after leaving the Mazoe River in Southern Rhodesia, we saw the wide, blue Zambesi. The Barotse had brought us through.

Those Barotse! Before I had left Portuguese East I was to learn more of their quality. And on returning to Northern Rhodesia two years later, to finish what remained in our dreams of life with game and camera, they again proved that they were men among men. They haunted me. What was it in Barotseland, I wondered, that produced these leaders?

A spell is a spell is a spell, and although I had to wait seven years, I turned to Africa for a third time. I was determined to go to Barotseland and finally answer my questions for myself.

So once again I was headed for country about which no one could tell me much, following trails that were vague even to officials in Livingstone. At that time, the usual route into their country was by paddling for three weeks up the Zambesi River. And so at last I reached the home of those Barotse and lived among them for three months, learning of their traditions and the freedom with which they live a life that is their own.

Some months after I left Barotseland, the Paramount Chief Yeta III, son of Lewanika for whom Mafaeking once hunted, wrote me. As is the custom, he addressed me as "My friend." "My friend," Yeta wrote, "since you have left my country, we are living in peace, all people whom you know."

When I was in Africa again not long ago, I was unable to get north of the Limpopo River, but I inquired about the Barotse from an old friend, who covers the continent with a camera and had been among them since my last visit.

"They're getting surly," he told me. "They're not the same people you knew. In the past few years the Recruiting Agents have been allowed to go in and hire them for the mines of South Africa. You would find changes if you went back."

The Barotse have gone out to work for years, so it is not just the mines, I thought sadly. At the mines, there is no one to respect them if they lift their heads and say proudly, "The Barotse are known." Who cares? They are but anonymous workers, supervised by men steeped in the doctrine of White Supremacy.

At the mines and in the factories there is no call for the forthrightness and courage of a conquering tribe. Their manhood is denied, and they are merely "boys," classed as unfit to share in that white man's world they once thought glamorous and desirable.

And yet, as a friend of mine in South Africa once sadly said of the African, "It would be so easy to make friends of these people!"

So I had found it.

 Continued from page 50

I am bound to add, however, that I doubt if this particular account is actually true. My reasons are simple. The distance involved here is so great that the chances of an accidental return are very slight indeed. Furthermore, there is, so far as I know, no reliable evidence that would render this anecdotal material credible.

Of course, cats can find their way home from any point in the territory with which they are familiar. This is based upon simple learning and is no more mysterious than a child's ability to walk home from school. Genuine homing ability may be something quite different. We're not certain as yet whether learning can account for the capacity of some birds to fly hundreds of miles over strange country and eventually return to their own nests. This is not the place to enter into a discussion of the various theories that have been proposed as explanations of homing; but it should suffice to state, more or less categorically, that there is no valid evidence to suggest that cats possess homing ability as distinct from the ability to learn their way about the world in which they live.

Written by an eleven-year-old boy:

"Thank you Grandpa, for renewing my subscription to NATURAL HISTORY, which is my favorite magazine and it would be terrible if I had to stop getting it."

Regular and Special Lectures at the Planetarium

The regular lecture at the Hayden Planetarium during February will be entitled "Conquest of Earth." It will demonstrate the close relation between astronomy and geography and show how the stars have aided man in mapping the earth.

Also in February, five special lecture courses will begin, on the following subjects:

Modern Celestial Navigation	Wed., Feb. 1	7:15 P. M.
Applied Navigation	Mon., Feb. 6	4:00 and 7:15 P. M.
Young People's Astronomy	Sat., Feb. 18	9:45 A. M.
Why the Weather	Thurs., Feb. 23	7:00 P. M.
Astronomy Without Mathematics	Tues., Feb. 28	7:15 P. M.

These one-lecture-a-week courses are carefully streamlined to clarify basic concepts in an authoritative yet not too technical manner. The introductory sessions, on the dates listed above, are open to interested persons without charge. For further information, call or write the Hayden Planetarium.

▲ GULL TALK: an unusual photograph taken by Karl Stulcken in Germany

Art by the Inventor of the Telegraph

New Yorkers will be given the opportunity to view from 35 to 40 paintings executed by the talented Samuel Finley Breese Morse, between January 19 and February 28 at the American Museum of Natural History.

The exhibition is being sponsored by the National Academy of Design as a tribute to its first president, who distinguished himself in the world of art on both sides of the Atlantic long before he became more widely known as the inventor of the telegraph. The exhibition also serves to inaugurate the 125th year of the establishment of the Academy.

Samuel Morse was a prolific painter. There is no record of the number of paintings that came from his brush, but 307 are known to be in existence today. They are catalogued in private collections and museums in this country and abroad. His full-length portrait of Marquis de Lafayette, considered by some critics as one of his finest, hangs in New York City Hall. It is being loaned for the exhibition. Others of his works are coming from a number of the foremost museums and from the private collections of the Morse family.

The only sculpture known to come from the hands of Morse is a plaster cast of "The Dying Hercules," which he used as a model to paint the subject on a canvas measuring 96½ x 78 inches. These works were executed in London by Morse in 1813 and received highest praise from the London critics.

In the beginning of his artistic career, Morse had planned to devote himself to historical paintings, but after his return to America in 1814 he set out as a portrait painter. First establishing himself in Boston, then traveling through several New England towns in quest of sittings, he

eventually opened a studio in Charleston, South Carolina, where he was very successful at first, having at one time more than 150 commissions in advance. His portraits include many of the distinguished personalities of his day.

Morse, the inventor, will be represented at the show by a large and well-planned display of his accomplishments in the field of science and invention. Valuable pieces from the Smithsonian Institution will be exhibited, including the first telegraphic instruments used; medals the inventor received from foreign governments (Morse was the most bemedaled man in American history up to his time); pieces of the original Atlantic cable; the first Morse camera, which he used as a pioneer in the field of photography while professor of Literature of the Arts of Design at New York University; and hundreds of other Morsiana items from educational institutions, libraries, and historical societies.

Museum Spring Dance Series

Dances from Europe, Asia, Africa, and America will highlight the spring program entitled "Around the World with Dance and Song" at the American Museum of Natural History.

Uday Shankar, generally considered one of the greatest Hindu dancers of all times, will open the series on February 9 with a program composed of new works and repertory favorites from other years. Mr. Shankar, a superb artist of rare caliber, recently completed an engagement at the Forty-eighth Street Theater in New York.

On February 23, "Mara," foremost exponent of Cambodian and Siamese dancing, will offer the intriguing "Apsara"—dying art of the lost Khmer civilization which mysteriously vanished centuries ago. Delakova-Berk and Company will appear on March 9 in dance scenes from Europe, America, and the Near East; and Kolya and Vinya will present authentic dances from Russia on March 23.

On May 4 Pearl Primus, just back from a year's expedition in Africa, where she studied native dances on a Rosenwald Fellowship, will offer an exciting group of African ceremonial and social dances based on her studies.

Dances and music of ancient India by Wasantha Singh, Indian scholar and musician, and his daughter, Lakshimi, will be offered April 20. And for the final program of the series on May 18, La Meri and Myra Kinch will present a group of new modern works based on traditional ethnic forms.

The series, to be held in the Museum's main auditorium, will include an afternoon program at 3:30 P. M., to which children are admitted, and an evening program given by the same artists at 8:30 P. M. All seats are reserved. Information regarding tickets may be procured from Hazel Lockwood Muller of the Museum's Department of Education: ENdicott 2-8500, Ext. 248.

BOOKS

Continued from page 55

tation of what is known about the question of racial superiority.

The greater part of the book lies under the heading of Part Four: "Primitive Society." Here, Subsistance and Crafts, Marriage and Kin, Status and Social Role, Property, Social Control, and Religion are subheadings, under which are grouped brief but clear discussions of principles and classificatory units. In most instances, the material is illustrated by the description of an appropriate portion of a primitive culture. There is not too much of this—just enough to clarify the point that the author wishes to make. While the emphasis in this section is on the simpler cultures, there is enough reference to our modern civilization to make it clear that the forms and mechanisms being discussed apply to present-day western culture as well as to that of the Bakongo.

Part Five, "Society and Culture," discusses some of the larger concepts developed in anthropology—Society and Culture, Culture Areas and Culture Systems, Personality and Culture, Invention and Diffusion—and then gives what is perhaps the best presentation of present-day concepts of cultural evolution that has appeared in a textbook.

The book is written in an interesting style and is relieved by occasional bits of humor, but the bit on page 101 doesn't help much. I would like to see authority cited for the statement that roasted and pounded ants are "known as Shoshone *ante-pasto.*" The book is arranged in effective textbook format with bold type subheadings.

JAMES A. FORD

AUDUBON'S AMERICAN BIRDS

from plates by J. J. Audubon
--- Edited by Sacheverell Sitwell

Batsford Colour Books, London, $2.00
12 pp., 16 illusts.

THIS slim volume, of crown quarto size, justifies the publisher's claim that it reproduces "directly, and with a fidelity of colour not hitherto achieved," sixteen selections from one of the finest illustrated works of all time. The exquisite plates were engraved and printed in the Netherlands. They testify to the marked superiority of European low-cost color work over any equivalent now obtainable in the United States.

The accompanying 12 pages (8000 words) of text by Sacheverell Sitwell are informing, discursive, gratuitous, stimulating (in the galvanic sense), opinionated, and sometimes exasperating. In the course of an essay dealing with ornithologists, artists, illustrators, authors, American Indians, New Zealand aborigines, game cocks (a masterpiece!), and what not, it is really possible to learn something about John James Audubon, his antecedents, collaborators, rank as a creative genius, and place in the Romantic movement that flowered contemporaneously in several arts.

It is no disparagement of the editor's sensitive appreciation of Audubon as a painter to point out how little Sitwell knows of birds and some other things. He extols the flowers in a number of the plates but omits, as did Audubon himself, to credit Joseph Mason, the lad who limned them around the master's birds. He informs us that the Carolina paroquet is "probably extinct"; that birds of blue plumage are rare in nature (which they are not). He obviously believes that our big American stork, the "wood ibis," is an ibis; that there is an "olive-sided nutcatcher"; that the wood duck and Carolina duck are different species. And he caps the climax with such solecisms as that the eider duck is more often found on rocky coastal islands than "in wooden swamps and hollow trees," or that "perhaps the African flamingo is a little paler, more roseate, than the American."

R. C. M.

A NEW THEORY OF HUMAN EVOLUTION

---------- by Sir Arthur Keith

Philosophical Library, $4.75
451 pp.

THIS new book by Sir Arthur Keith attempts to present the story of man's evolution and his differentiation into races. In Keith's view, the essential mechanism that controlled this lengthy process of a million or so years was the psychological nature with which the forerunners of man were endowed. This was a combination of dual but contrasting biases (derived from instincts): love for one's own kind and hate for others, co-operation and competition, together with a variety of other impulses that enforced these. By virtue of these innate characteristics, men in the primal days of their evolution were immured in small, mutually hostile, and competitive bands which as a corollary meant that they bred within their own group, thus preserving and working out the destiny implicit in this genetic endowment.

The fossil record of man's history is also analyzed in detail, and the author concludes that the various races of today all derive their origin from Australopithicinae in Africa, became separated at an early stage and evolved independently within their present geographic bounds.

Finally, modern nationalism is pictured as a continuation of the original, inbreeding primal group whose evolutionary function it has taken over.

Unfortunately, the conception presented here abounds in unacceptable assumptions and is open to innumerable objections. One cannot help feeling that the reputation of the author has not been enhanced.

HARRY L. SHAPIRO

March NATURAL HISTORY 1950

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LETTERS

"Monster's" Enemy

SIRS:

"Monster of the Mist Forests," in your January issue, contained the following paragraph on page 23: "Other than man, the black rhino has few enemies. However, one notable exception, or so legend has it, is the elephant. . . ."

The "or so legend has it" brought to mind a scene I witnessed and photographed some years ago at the Brooklyn Zoo. The elephant and rhino had been standing "toe to toe" making threatening gestures at each other for some time. Finally, the elephant rushed the bars, brandishing his trunk. The rhino responded with a short charge that ended abruptly at the massive bars. The elephant took the round by turning quickly and smashing a left rear hook that shook the rhino, wedging his head between the bars.

That seemed to take the fight out of the rhino. He withdrew his head, turned, and trotted off, snorting something to himself which I am sure would be unprintable if translated.

MURRAY GORDON

Bronx, N. Y.

Shy Turtles

SIRS:

This is to ask why turtles are so shy and fearful. I can't understand this when, as nearly as we have been able to observe during many summers at lake and stream, there is nothing except an occasional small boy that would threaten one of these animals. No creature on the Russian River is harder to approach. I have seen a half dozen or so flop hastily off a log when I quietly rounded a bend in the stream 100 yards or so away. Frogs and rabbits, both with many enemies, are far easier to approach. What teaches a turtle fear?

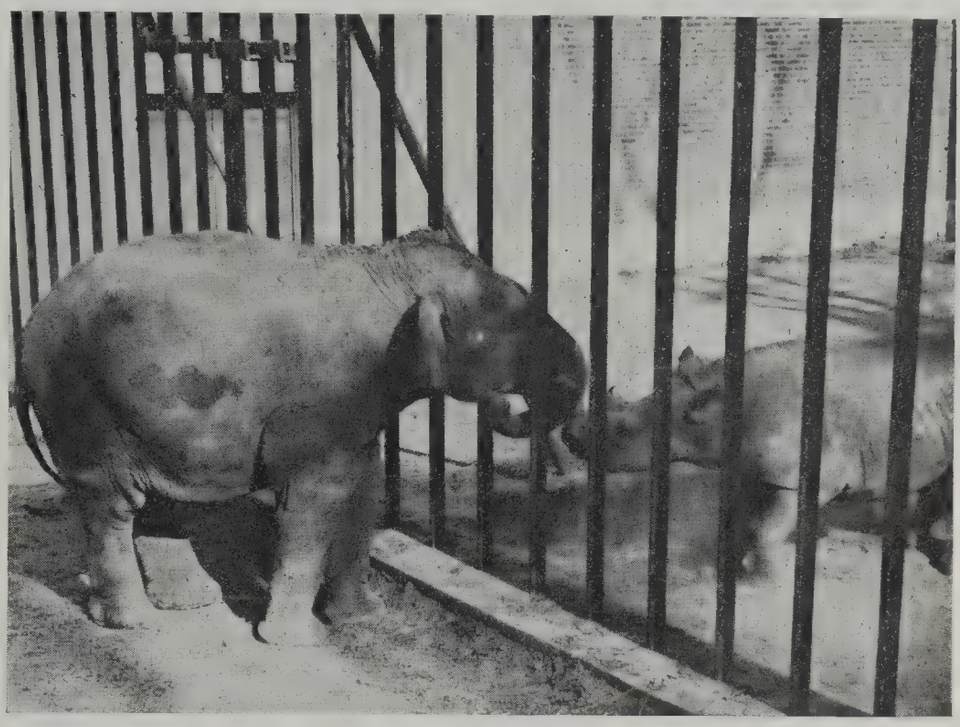
MAX. L. CONNER.

Alameda, Calif.

The following comments are offered by Mr. C. M. Bogert of the American Museum's Department of Reptiles and Amphibians:

The question of why turtles are so shy and fearful is not easy to answer. Some

NOTICE—Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on these pages will be paid for at $3.00 each, with full credit to the photographer. Return postage must be included.



kinds of aquatic turtles are more wary than others, but even within a single species they may differ from place to place. Innate behavior may be modified by conditioning. That is, a turtle belonging to a species that is ordinarily wary may become used to the presence of animals that appear on the horizon but do not disturb it. Even the shyest of turtles in zoological gardens eventually are quite undisturbed by the presence of people. But if every visitor attempted to climb into the zoo's enclosures to catch the reptiles, they might retain what was probably the normal impulse prior to capture and flop into the water as soon as a human head appeared over the railing.

It may safely be assumed that the turtles in the Russian River, presumably Pacific pond turtles (*Clemmys m. marmorata*), have other enemies aside from the small boys that pester them. Innumerable animals devour the eggs or recently hatched young of most turtles, but the protective armor of adults discourages attack by a good many enemies. Nonetheless, there are various carnivores, including raccoons, possibly otters, and alligators in the southern states that readily crack the shell or even engulf the whole turtle if it's not too large. Without making a careful survey in the region, it is doubtful whether an adequate guess could be made concerning possible predators in the Russian River—but they are almost certainly present.

It is noteworthy that on some islands where predators are scarce or nonexistent the close relatives of wary mainland forms are often quite easily approached. The whipsnakes on Clarion Island, for instance, can be approached by man and picked up with ease, whereas their relatives in Mexico and the American Southwest are among the more difficult snakes to capture. Habits may be modified in this way, either by environment or by selection, to produce the same result. It has been suggested, for example, that in most parts of the South, where the remaining alligators take to the water upon the approach of man, such extremely cautious behavior is the result of selection. This is to say that the wariest animals have survived to transmit to their offspring what is assumed to be a hereditary trait. Early travelers in Florida reported these large reptiles to be present in great abundance, with the rivers literally swarming with aggressive alligators that did not hesitate to attack men in canoes. Now most large 'gators flee to the deepest available water before a hopeful observer can get a good look at them. In places where they are not actually hunted, as at Silver Springs, an occasional large individual may be seen basking on the bank of the stream, and boatloads of tourists can be brought within 50 feet or so. Yet a truly aggressive alligator is not likely to be encountered.

As for those Russian River turtles, they are probably molested more often than casual observation might lead one to believe.

"Stop, Thief"

SIRS:

In Rocky Mountain National Park, Colo., I placed a peanut on a rock, hoping to get a picture of a ground squirrel. Just as I was getting in focus, a bird zoomed in from apparently nowhere, I shot, and when I developed the film I was very happy to see I had made the exposure at the exact moment when this Canada Jay or "Camp Robber" picked up the peanut.

MRS. THASE DANIEL

Norphlet, Ark.

History of the Siamese Trees

SIRS:

This morning I received my February issue of NATURAL HISTORY, and after marveling at the colors of the Pinguin on the cover, I turned the page only to see a picture which took me back 46 years, to be exact. I am referring to the letter from C. J. Bates with the picture of the natural graft between the two sycamore trees.

Before reading Mr. Bates' letter, I knew exactly where these trees were. I was born in Rutherford, and when I was about ten or twelve years old I lived within a half mile of these trees. I remember when they were separate. The limb of the larger tree, when I first noticed it, was wearing a hole in the smaller tree, and we could hear it rub when the wind blew. Then, as the limb grew, it imbedded itself in the smaller tree, making a solid connection. Apparently the chafing of the bark by each tree started the graft.

It may be possible that someone before my time, seeing that this limb was growing straight toward the smaller tree, purposely cut off the end of the limb in the hope that it would grow into the other tree, as it did. However, since the readers of NATURAL HISTORY are nature lovers, let's believe that this was entirely the work of Mother Nature!

ARTHUR E. DAVIDS.

Hartsdale, N. Y.

SIRS:

Referring to the Siamese trees that one of your readers described in the February issue, may I say that in a place at the outer end of Penzance Peninsula, Woods Hole, Mass., there are a number of European beech trees (*Fagus sylvatica*) that have become almost a tangle of natural grafting.

BASSETT JONES

New York, N. Y.

"Rain of Frogs"

SIRS:

My husband related to me an interesting phenomenon that he witnessed while returning to Clarkia, Idaho, on horseback. A cloud suddenly appeared, followed by a severe thunder and lightning shower. When he reached a draw, the rain had ceased and the sun was shining, but the

Continued on page 142

NATURAL HISTORY

The Magazine of the American Museum of Natural History

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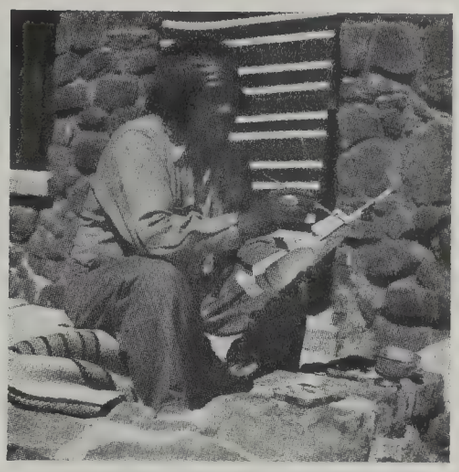

THE COVER THIS MONTH

This happy Hopi Indian is Jimmy Kewanwytewa of Old Oraibi, Arizona. He is a familiar figure to those who visit the Museum of Northern Arizona, at Flagstaff, where Jimmy is official "Custodian." The costume you see is typical of the traditional Hopi man – colorful headband, Dutch haircut, work shirt, and dungarees.

Jimmy spends much of his time carving kachina dolls and has earned an enviable reputation in this art. These colorful wooden dolls represent the spirits of many different supernatural beings. They are sometimes carried in ceremonials and later given to the children so they will learn to know them. More than 200 different kachinas are included in the Hopi pantheon. The dolls are brightly painted and decorated with hawk feathers.

Jimmy makes most of his dolls for the Museum's own collection, but a few are sold to lucky collectors. On week ends you will find him back at his family home, high atop an isolated mesa in the middle of the Painted Desert. There he relaxes with his relatives and plans the kachina-carving he will do the next week.

Jack Breed

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YOUR NEW BOOKS

Hopi Kachina Dolls • History of Science
Audubon • Water Fowl • Game Fish

NEW WORLDS EMERGING
---------- by Earl Parker Hanson

Duell, Sloan, and Pearce, $3.50
385 pp.

THIS is a readable and stimulating book, because its author is a stimulating and forceful man. He has seen much of the world and has given his best to help solve some of the problems that have arisen under a wide variety of human and environmental conditions.

Hanson's thesis is militant, but optimistic. Granting short shrift to racial prejudice and repression, he bets his purse on the underdog. He points out that "westward-ho!" has now run its global circuit and that civilization is busily turning at right angles into the traditional wastelands, *i.e.*, northward to the sub-Arctic and southward to the Amazon basin and similar areas. Now that man has more or less stopped insisting that these regions can't be occupied by people of high living standards and has begun to ask how best to bring it about, the end, writes Hanson, is assured. In his descriptions of the wide topographic and climatic variety within, for example, Alaska and Amazonia, and the resulting ecological niches for satisfactory human cultures, the author is reasonably convincing.

So far, so good. But it is hard to see why Hanson pooh-poohs such well authenticated, even if gloomy, pictures of man's plight as that in William Vogt's *Road to Survival*. Vogt surely learned his geography "in the field." In fact, Hanson to the contrary, there *is* no other kind of geographer.

Man has overbred in a large part of the terrain thus far found habitable. He has used up priceless resources nearly everywhere. Hanson completely ignores the fact that the destruction already stands up like a sore thumb in vast areas of South America and Africa, two of his pet continents. He plays up the African peanut project at a bad moment, because the current status of that grandiose plan augurs a fiasco.

Hanson's argument, indeed, falls frequently into traps of its own making. There is no parallel between the fifteenth century saving of Europe by the discovery of the New World and the "saving" of the modern horde of two billions (more tomorrow and mostly hungry) by the most intensive possible development of a residuum that is at least partly submarginal. The completely fascinating chapter on Iceland is a case in point. In all seriousness, it beats Horatio Alger, but Hanson is here dealing with a land of fewer than 200,000 people, a density of 3.3 to the square mile!

R. C. M.

I MARRIED A DINOSAUR
---------- by Lilian Brown

Dodd, Mead and Company, $3.00
268 pp., 18 photos

THIS is a bride's-eye view of a veteran fossil hunter. Lilian met Barnum Brown during a tour of India and married him there. Her book deals with the first two years of their marriage, spent in various parts of India and Burma.

Mrs. Brown relies a little heavily on the use of exaggerated slang, presumably for the sake of humor, but she does have the gift of natural writing, and many of her stories are genuinely funny. The descriptive passages are quite beautiful and reveal an excellent memory for details and impressions.

Very few women, I should imagine, could adapt themselves so cheerfully to camp life in a strange country. Lilian Brown describes as amusing several experiences that should have been, and perhaps were, rather terrifying. Her only complaint, throughout the book, is that her husband was too busy bone-hunting for them to have a real honeymoon.

Far from moping about it, she successfully occupied her time by making friends with the natives. Very wisely, she made no attempt to understand their way of life. She simply liked them, and they, her. In these days of suspicion and mistrust of any difference between peoples, such an approach is heart-warming.

In this account no dates are mentioned; this makes it difficult to place the book in time. This is a minor point, however, for the adventures of Lilian and Barnum Brown are so fresh and gay that they might have taken place only yesterday.

MARTHA R. BOGERT

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HOPI KACHINA DOLLS
---------- by Harold S. Colton

University of New Mexico Press, $7.50
20 figs., 8 in color; numerous line drawings

NEARLY every traveler to the southwestern United States—particularly if he is interested in the present-day Indian population—is familiar with the kachina dolls manufactured in the Hopi villages of northeastern Arizona. Perhaps he has acquired one of these engaging wood carvings and is curious to know its history and what it is intended to represent. It is to such an audience that the present handsome and informative volume is directed. It should in addition prove useful to the serious student of the American Indian.

To the Hopi Indian the term "kachina" is employed in three different contexts: first to mean a supernatural being, second to designate a masked dancer who, during certain ceremonies, impersonates this spirit. Thirdly, kachina refers to the small painted wooden effigies that represent both the supernaturals and their masked impersonators. After the ceremony for which they are made, these dolls are given to the children, not as mere toys, but as a part of the youngsters' religious training. Kachina dolls, therefore, are neither idols nor ikons but only objects used in the education of the Hopi child.

Since the Hopi recognize over 200 kachinas and frequently invent new ones, the problem of identifying any particular supernatural is complex. The Hopi art style, moreover, is extremely stylized and symbolic, so that the identity of a given kachina must be determined from details of the mask, body painting, ornaments, accessory objects, and the like. The two longest sections of the book are devoted to careful descriptions of the various kachina dolls and to a convenient key designed to assist in their identification. Both of these sections are abundantly illustrated with schematic ink drawings. There are in addition excellent photographic plates, eight of which are reproduced in full color. These latter happen to be the work of Jack Breed, who photographed the scene reproduced on the cover of this issue of NATURAL HISTORY.

HARRY TSCHOPIK, JR.

An Illustrated Key to the Lizards, Snakes, and Turtles of the West

by Jay M. Savage

Naturegraph Co., Los Altos, Calif., 50c
32 pp., illustrated

THOSE who want to make field identifications of the reptiles found west of the Rocky Mountains will welcome this 32-page pamphlet. It is small enough to be tucked into a shirt pocket and yet ample for the intended purpose, even to the inclusion of reasonably accurate distributional maps.

C. M. B.

The Quails

by Edward S. Spaulding

The Macmillan Co., $6.50
123 pp., 7 color plates

THE scope of this volume is more restricted than the title would indicate. Aside from a chapter on the introduced Hungarian and chukar partridges, the author limits himself to the six or seven kinds of quail found in the United States. Of these, the best known is the eastern bobwhite, but all its handsome crested relatives are natives of the Southwest. Fortunately, Mr. Spaulding is a Californian, and he has made the most of his opportunities to study these engaging birds at all seasons and under all conditions. His informal accounts of their habits, though written as a sportsman, reflect a mature appreciation of nature and an enlightened approach to such controversial matters as predator control. Of the almost mythical masked bobwhite, long extinct in the United States and nearly so in Mexico, he of necessity speaks in general terms, but the chapter on the elusive and bizarre Montezuma quail contains much valuable, hard-won information.

The seven colored plates are the work of Francis Lee Jaques. Although the details are not always beyond criticism, these paintings possess striking beauty and will insure for the volume a somewhat wider audience than that provided by the sportsmen to whom it is primarily directed. For reasons undivulged, the elegant quail, a Mexican species scarcely mentioned in the text, was selected for the frontispiece.

Dean Amadon

A Short History of Science and Scientific Thought

by F. Sherwood Taylor

W. W. Norton and Company, $5.00
368 pp., 28 plates, 53 figs.

THE author is the Curator of the Museum of History of Science at Oxford, and now science would appear to have, by title at least, a qualified historian. This short history covers a vast spread in scientific thought, ranging from the work of early Babylonian and Egyptian scientists to that of the scientific thinkers of today. There is a general running history of science, but certain concepts are treated in more detail, such as developments in the fields of chemistry and nuclear physics. Taylor thus attempts to show the dependence of today's science upon scientific thinking of the past. In general, the book is coherent and logical in its progression through time, and a generous sprinkling of illustrations serves to enlighten the reader. Included are many original drawings and diagrams of the scientific discoveries of the past. Four of the chapters give the reader a brief but informative history of the steps leading to the atom sciences of today.

A dynamic quality is given to this history by the inclusion of a series of short but well-selected readings from the great scientists from the Babylonians to Einstein. These selections help to orient the reader and give the flavor of scientific thought in the several eras of science discussed, which would be difficult to impart if done only in the words of a twentieth century historian.

It is only in the last chapter that the author becomes noticeably subjective and indicates his alarm over the path the world seems to be taking. He strongly expresses the opinion that it is high time that the men of science become ethical as did the men of medicine. Science is a tool, but the author realizes the power of the tool and thereby the power of the men who wield the tool. Taylor questions whether scientists will try to control their science. He does not answer this question but pleads for watchfulness in these significant times.

John R. Saunders

Allen Latham's Bee Book

by Allen Latham

Hale Publishing Co., Hapeville, Ga., $2.95
200 pp., 3 illusts.

THE incorporation of the author's name into the title of this book is appropriate, for after 65 years devoted enthusiastically to the keeping and observation of bees, a person presumably has yoked his personality so completely with the object of his interest that they form a complementary whole. The title has equal validity because the author inclines to be heterodox in his interpretations, and even his observations are often rather at variance with those of other investigators. Thus it is well to know from the start that the book is in large part a given individual's experience rather than a weighted summary of the conclusions of others.

The book will have special interest for fellow apiarists, who have faced problems of much the same character as those with which the author was confronted in the course of his long career. For many of these problems he found happy solutions. His interpretations of bee behavior are often stimulating, even if at times unusual.

One could wish he had taken more cognizance of the work of others, particularly in those cases where his own observations are at variance with theirs. His timetable of the successive functions—nursing, building, foraging, and the like—of the individual bee does not coincide with that of an investigator like Rösch; and his statement that bees follow the discoverer of a source of nectar takes too little cognizance of the conclusion reached by von Frisch, on the basis of painstaking experiments, that the character of the "dance" executed by the discoverer of the nectar reports the location with sufficient accuracy to dispense with the necessity of having the discoverer lead the way to the nectar supply.

The book has its defects. But as a personal record of an interested and enterprising apiarist with a healthy curiosity regarding his bees and their relatives (in which he includes the rather too remote termites), it is to be commended.

Herbert F. Schwarz

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The Saga of the Waterfowl

by Martin Bovey
Cover and title page designs by F. L. Jaques

Wildlife Management Institute, $5.00
141 pp.

THRONGS of waterfowl once inhabited the vast marshes and innumerable prairie sloughs of North America. A slow decline in their numbers began almost with the arrival of the first western pioneers. Marshes were drained and spring shooting decimated the birds as they attempted to nest, while commercial hunters slaughtered them on Chesapeake Bay and other winter concentration areas. The abolition of market gunning, along with other protective measures, slowed but did not halt this decrease, for the destruction of habitat continued apace. Then, in the late 1920's, a series of dry years added their disastrous impact. The Dust Bowl appeared, and though its human casualties made their hazardous escape to California or other havens, nesting waterfowl

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were doomed. Belatedly aroused private and public agencies strove to improve matters by tightening game laws and by restoring marshlands. The results have been as good, perhaps, as could be expected, but the ever-increasing army of sportsmen and the ceaseless demands of agriculture make the future of our ducks and geese a precarious one.

This *Saga of the Waterfowl* is here depicted in a series of dramatic photographs. The text is merely a terse, running commentary that averages only two or three lines per page. Mr. Bovey's photographs are not waterfowl portraits; rather they are panoramic views of marshes and destroyed marshes, of duck hunters and would-be duck hunters who find their sport has vanished. When birds are present, they often are little more than silhouettes against sky or water.

Let us hope that this graphic plea for conservation will help us realize that wise management of marshlands and water resources is of crucial importance not merely to waterfowl but to man himself.

DEAN AMADON

GAME FISH OF THE WORLD

- - Edited by Brian Vesey-Fitzgerald and Francesca LaMonte

Harper and Bros., $15.00
446 pp., 80 illusts.

THIS book, an authoritative and interesting treatise, is a compilation of contributions from well-known and widely recognized sports fishermen, including Major K. Dawson, Dan Holland, Lou S. Caine, Ollie Rodman, Philip Wylie, George C. Thomas, III, William W. Lovett, Jr., S. Kip Farrington, Jr., Ernest Hemingway, Michael Lerner, Van Campen Heilner, Leander J. McCormick, H. D. Turing, Norman L. Weatherall, N. K. Robertson, T. C. Roughley, Dr. Henry Gillet, W. W. Small, and Lt. Col. R. B. Phayre. More than 100 species of game fishes are shown in outstanding color plates by Dr. A. Fraser-Brunner.

Each contributor to *Game Fish of the World* was especially selected because of his knowledge of the subject on which he wrote and of the area or territory in which the fish under discussion lives. The result, combined with an excellent piece of editing, is a series of articles that are little short of amazing in their detailed coverage —something that all anglers can either read with pleasure or study with interest.

Game Fish of the World is divided into six parts, the first of which contains a thorough exposition on salmon. Part 2 takes in the favorite game fishes of North and South America, while Part 3 has the game and coarse fishes of Great Britain and Ireland as its subject. Australian game fishing is treated in Part 4, African game fishing in Part 5, and the game fishing of India in the last part of the book.

This one volume contains a variegated knowledge of the world's most highly-prized game fishes, knowledge that took each contributor many years of application and many thousands of dollars to learn. This information, thoroughly up-to-date, is now passed on so that other anglers may have the benefit of wide fishing experiences. Many gamesters that most anglers have heard of only vaguely are pictured in color, and the book will serve as an introduction to these gamesters.

In addition to these fine color likenesses, this introduction is complete with word pictures written by anglers who somehow manage to carry the reader along with them on the fishing trips they so vividly describe. Thus the angler is enabled, sitting comfortably by his fireside, to visit and fish (in effect) in such places as Alaska, Spain, the British Isles, Australia, New Zealand, South America, Africa, and India. It truly opens to the angler a piscatorial vista heretofore denied him, or enables him to relive the experiences of his own fishing trips to near and faraway localities.

In conclusion, we would unhesitatingly express the opinion that *Game Fish of the World* is perhaps the most useful volume on game fishing that has ever been presented to the angling public. That it deserves a special niche on the bookshelf of every angler goes without saying.

ERL ROMAN

NORTH AMERICAN FRESH WATER SPORT FISH

- - - - - - - - - by Lou S. Caine

A. S. Barnes & Company, $5.00
212 pp., 91 illusts.

THIS book is by one of the most unassuming, competent, and popular anglers in North America and is a thoroughly reliable job. The sections headed "Biological Facts" were written by Dr. Karl F. Lagler, an ichthyologist already well known to anglers as one of the co-authors of "Fishes of the Great Lakes Region," by Hubbs and Lagler.

The method of handling such material has become almost standard, but here there are several valuable additions. As usual, the fishes are arranged in their correct groups, headed by a short general discussion of the group as a whole. The individual fish is then taken up under various standard headings: name, scientific name, range, habitat, color, size, food, distinguishing characteristics, and a section called "biological facts" which deals chiefly with spawning habits and growth rate. To these more usual sections there have been added paragraphs on fishes as food and as game, and on artificial lures, and fishing methods. The most valuable addition of all, however, is the inclusion of a line cut for almost every species, illustrating the outstanding external peculiarities [or] distinguishing characters of the fish in question. These

cuts are large and very clear and should be of great use to the angler in identifying his catch. The black and white illustrations and color plates are excellent.

At the end of the section on fishes, there are well-illustrated and clearly written sections on tackle and methods. These are followed by a reading list for anglers and an index.

This book has been prepared in a careful, orderly, and attractive way by a man who knows a great deal about fishes and everything about how to catch them.

F. LaMonte

The Sandhill Cranes

- - by Lawrence H. Walkinshaw

Cranbrook Institute of Sciences,
Bloomfield Hills, Mich.
202 pp., 5 maps, 18 pp. of illusts.

Only two species of cranes inhabit North America, but these stately birds have an importance for the naturalist beyond what mere numbers might suggest. Although the great white whooping crane is now nearly extinct, the brown sandhill crane is still found in many parts of the continent. For the past fifteen years, Dr. Walkinshaw, the author of this volume, has devoted the spare moments snatched from a busy professional life to an intensive study of the sandhill crane. His quest has taken him from the tundra of Alaska to the palm-dotted savannas of the Isle of Pines, accompanied at times by a pet crane, reared in captivity to throw further light on the behavior and development of this species. Zoos, museums, and libraries were also visited in his search for information.

The present volume, crammed with facts and supplemented with tables, bibliographies, and a key to the cranes of the world, is the result of this concentrated effort. Ecology, life history, migration, and conservation all receive detailed treatment. A book to be valued for either reference or enjoyment, it is a model of what an amateur ornithologist can accomplish by a carefully planned program.

Like other Cranbrook Institute publications, this book is well made. The cover design depicts a crane with neck upstretched watching three others in flight, while a beautiful Kodachrome of a sandhill crane taken in Alberta by B. W. Baker serves as a frontispiece. Of even greater value are 33 black and white photographs of cranes and their nests and eggs taken in all parts of the range.

Dean Amadon

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JOHN JOHNSON
R.F.D. #2 North Bennington, Vt.

A Traveler's Guide to Roadside Wild Flowers, Shrubs and Trees of the U. S.

- - - - - Kathryn S. Taylor, Editor

Farrar, Straus & Co., $3.00
182 pp., 4 color illusts., numerous drawings

Botanical publication has finally entered the automobile age in this streamlined little book, replete with reciprocating machinery that seems to work. Arranged according to color is a list of 743 species of trees, shrubs, and herbaceous plants, each with a few descriptive words and many with marginal thumbnail illustrations. The accompanying locality abbreviations are geared to three maps of the United States that show state boundaries and the major landform areas.

Part 2 is an alphabetical arrangement of states, each with an outline map and with such accessories as the best automobile routes and a picture of the state flower. The reader of the book travels along, and according to season sees by the roadside "drifts of sky-blue lupine" or "shrubby cinquefoil" or "dwarf iris" or "Scotch broom," depending upon the state in which he is traveling. Then he notes the catalogue number and turns back to the systematic list in Part 1 to find the scientific name and family and general distribution of the plant under observation, or one very closely related. This arrangement saves space and eliminates much of the difficulty with common names, which often vary from state to state. Then there are listed "Centers of Interest" for our botanical tourist, such as museums, national parks, experimental farms, etc. The mechanism seems to have been checked pretty well for the identity of material to be included. There is a good bibliography. It occurs to me that the list might have included *Southern Wild Flowers and Trees* by Alice Lounsberry which though published in 1901, does not seem to have been surpassed for this region.

H. K. Svenson

The Life of Audubon

- - - - - - - - - - - by Clyde Fisher

Harper and Brothers, $2.50
76 pp., 20 plates, 53 figs.

There have been other more detailed biographies of this great painter-naturalist, whose plates adorn the walls of so many American homes. Yet this short life story, with pictures from the collection of the American Museum, will fill a definite need. Few men could better appreciate John James Audubon than our own Clyde Fisher, whose life was devoted to imparting enthusiasm for the study of nature and of our universe.

Audubon's life was nothing if not dramatic. Coming to Pennsylvania in his late 'teens, he was followed by rumors that he might be the lost Dauphin of France. The drawing of birds was his greatest interest. But he was expected to earn his living and so became a merchant in Kentucky. He had a loving wife, too, and soon there were two sons. His heart was not in business however; in another twelve years he was bankrupt.

At this point he found employment at the Western Museum in Cincinnati and decided to publish his collection of bird paintings. Many gaps remained to be filled; he started for Louisiana. "Without any money," he wrote in his diary of 1820, "my talents are to be my support and my enthusiasm my guide in my difficulties."

Before he could secure subscriptions to his "Birds of America," to be published in double elephant folio, he must visit Great Britain. For 20 years he traveled, hunted, painted, and edited; he proved himself by far the greatest salesman of natural history publications in his day.

That huge task completed, he settled in New York and soon was off again to the upper Missouri. The "Quadrupeds" were still to be done, but that work was only completed by his sons. Naturalists are apt to rate Audubon higher as a zoologist than as a painter. The artists extol him as one of their own. No doubt both sides are right.

James P. Chapin.

The History of Nature

- - - - - By C. F. von Weizsäcker

University of Chicago Press, $3.00
191 pp., 8 illusts.

It is no accident that the men who are most profoundly disturbed by the implications of our rapidly expanding science are frequently to be found in the ranks of physics where they come closer, perhaps, than any other group of scientists to the terrifying aspects of massive power over nature and mankind. It was possible, Dr. von Weizsäcker says, for scientists of an earlier age to ignore the responsibility

Continued on page 142

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MISSION: *Malaria*

By HARRY HOOGSTRAAL
Field Research Associate,
Chicago Natural History Museum

THE United States Navy has seldom sent a mission on stranger sea duty than it did in 1948 when the Naval Medical Science Group, accompanying the University of California African Expedition, fought its heavy trucks through the thick sands of the Libyan and Nubian deserts and into the Sudan to find and domesticate elephant shrews infected with malaria.

An earlier report of malarial infection in a shrew in the Sudan suggested to Dr. Clay G. Huff, of the Naval Medical Research Institute in Bethesda, Maryland, the advisability of attempting to find and isolate such a parasite. If a small mammal naturally infected with malaria could be adapted for laboratory use, it would be a great boon to research on this disease about which we still have so much to learn. A large part of malaria research must of necessity be done on animals, and birds have been the most convenient subjects. But because man is a mammal, studies of the disease in another mammal would be much more conclusive and directly applicable. It has been brought to light in recent years that part of the life cycle of malaria occurs in fixed tissues of the host, in addition to the well-known phase in the blood. This has made the demand for an experimental mammal even greater than heretofore.

So when my old friend Commander Kenneth L. Knight phoned by long distance and told me I would naturally want to join the naval group in Africa for the purpose of ferreting out this and other animal diseases, it was impossible to refuse. True, I was thoroughly enjoying the wonders of America after having just returned from three years in the Pacific. But my spirit of adventure rose as I contemplated the fascination of visiting more strange places and of hunting animals and diseases that research scientists have been waiting for years to see and study.

The informality of expedition life, the association with people in all stages of civilization and levels of society, the thrills of solving a varied assortment of problems, and the never-a-dull-moment atmosphere of the work, outweigh, in my opinion, not a few of the advantages and comforts that are to be found in the fast and troubled tempo of more civilized parts of the world.

To reach the land of the elephant shrew, near the southern border of the vast Sudan and eastward toward the wilds of Abyssinia, we headed our trucks southward from Port Said through the fertile Nile Valley, with its centuries-old water wheels, millions of domestic animals, and cluttered villages. At Assuan, in southern Egypt, the desert "track" began.

For about ten days we followed

Official U. S. Navy photo

▲ LINKS in the exploratory chain. *Left to right:* Chief Deaner K. Lawless, Medical Research Assistant, U.S.N., who worked with the author; William Terry, University of California representative; Captain J. J. Sapero (M.C.), U.S.N., who assigned the party to the project. *Standing:* Commander T. K. Ruebush (M.S.), Naval parasitologist, and Dr. C. G. Huff, Malarialogist of the Naval Medical Research Institute, who initiated the undertaking

ewhere in the interior of Africa
e were elephant shrews
cted with malaria,
Navy expedition
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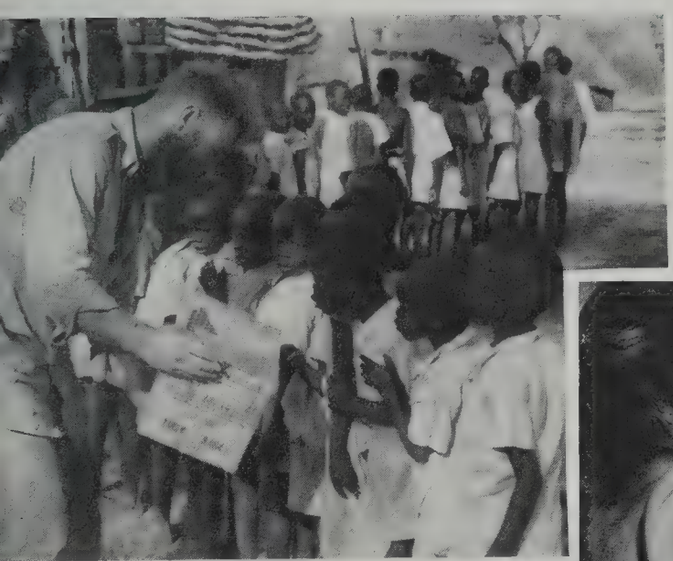
e about the disease
still afflicts
dreds of millions of human beings

U. S. N. photo by Harley J. Cope

▲ THE OBJECT OF THE QUEST: the elusive elephant shrew, sought in the hope that this small mammal would shed light on human malaria



U. S. Marine photo by Charles Evans

◀ RICHARD ALISON showing the captive shrew to school children at Kapoeta so they would know what to look for. Soon they were bringing in dozens of them

▼ STROKING under the chin makes the elephant shrew's mouth water. Then the animal is easily "hypnotized" and will remain motionless for a considerable time

Harry Hoogstraal photo

a vague camel trail or only the intuition of our Arab guide. Though we traveled slowly, we still had to stop sometimes while our guide scanned the vista of peaks and hills for his familiar landmarks. More often, however, we were halted when our heavy trucks floundered in soft sand and had to be winched out by lighter and more mobile trucks.

There is little variety over this great expanse of desert but rather a magnificent monotony that, like fire or running water, compels one to look and look. Now as our party looks back on the year in Africa, we all agree that the days in the desert held our interest as much as anything we saw on the whole continent.

MISSION: MALARIA

U. S. N. photo by Harley J. Cope

▲ HEADQUARTERS at Kapoeta. The author is showing the shrew to Commander J. M. Amberson, while Chief D. K. Lawless peers through the microscope at elephant shrew malaria

Even more than 25 miles from the nearest twig of vegetation a rare snake slithered from under a rock when disturbed, scorpions assumed their familiar offensive attitude, silverfish scurried away from their little piles of wind-blown debris, and praying mantises, curiously adapted for life in sand, raised their forelegs as they do the world over.

Scores of bleached camel bones along the track testified to the difficulty of the march, as did a human skeleton that our chaplain stumbled upon one day as he walked out to pray.

One day, our physicist was explaining how mirages are produced, when we noticed an unusual movement on the border of one of the lakes-that-were-not-there. Soon we were abreast of an advancing camel train of about 100 animals and a dozen men. Another night we were awakened from our bedding roll by the sounds of a camel train, wonderfully silhouetted against the cold, bright desert moon, shuffling through the sand and being urged onward by the low, steady chucking and calling of the drivers.

When we turned toward the Nile, where the hand of man has disturbed the serenity of the desert, the landscape lost much of its quiet splendor.

At Wadi-Halfa, the busy, sun-baked river town on the border of the Sudan, we paused to do a bit of medical investigating and mammal collecting. Then onward across hundreds of miles of desert, southward through the Sudan.

Just before Er Renk, about 300 miles south of Khartum, we left the country of the white-shrouded Arab and were startled to find ourselves abruptly among tall, thin, naked Negroes. During our next several months among these Nilotic tribes of the Sudan, we never ceased to admire them. Proud, primitive, sturdy, superstitious, honest, completely naked, and heavily ornamented, these Nilotics have been forced by the British to abandon most of their fierce intertribal warfare and to do some cultivating of the land; but otherwise, for the most part, they continue to live as they have for centuries past.

In the midst of this hardly tamed country lives the elephant shrew. A lucky clue dropped at Khartum during a conversation between Commander J. M. Amberson, who was in charge of our group, and an American missionary indicated that at Kapoeta in southeastern Sudan, these snouted little animals could often be seen running about in broad daylight. If we hurried we could skirt the tremendous morass of the Nile sudd just before the rains closed the packed mud road for many months to come.

At Juba, the last British installation in the southern Sudan, Commander T. K. Ruebush, Naval parasitologist, found so many important medical problems that he was regretfully forced to turn the elephant shrew project over to his assistant, Chief Deaner K. Lawless, Medical Research Assistant, USN. Chief Lawless entered eagerly into the work, and once at Kapoeta, we were soon spending sleepless nights searching for the pot of gold at the end of the rainbow—elephant shrew malaria.

At first we failed to get even a smell of what we had come for. Richard Alison, my bushy-bearded New Zealand soldier-of-fortune assistant, and I placed dozens of traps

▲ CHIEF DEANER K. LAWLESS buying elephant shrews from Taposa men at Kapoeta

Harry Hoogstraal photos

in the likeliest spots. All we caught in them were rough-haired grass rats and tiny, beady-eyed true shrews. Then, at last, a sick, maimed elephant shrew crawled into one of our traps one night to find a place of refuge.

The poor animal had little peace after we discovered it, for we collected everyone in camp to see the little beast that had lured us so far off the beaten path. In a moment we had a drop of its blood on a glass slide. It was stained, waved in the air to dry, and placed under the microscope. After the first quick look, everyone knew that we had found what we were looking for. Indeed, our first elephant shrew had the heaviest density of malarial parasites that we were to find in hundreds of animals examined during the next few months!

A day or two later, Major R. M. Allott, the commander of the local Sudan Defence Force base and the only Britisher for miles around, returned to Kapoeta and, being apprised of our need for large quantities of elephant shrews, took hasty action. Summoning the prisoners, the soldiers' children, and the native population, he had Alison parade the cage containing our prize elephant shrew up and down the lines of people, tell them what the reward was for each living specimen, and chase them off to capture more.

The elephant shrew that the people had seen in the cage was a reddish-brown, thick-furred little animal, some eight inches in length, about half of which was almost naked tail. Its hind legs were elongated like those of a rabbit, its forelegs reduced in length. The large, dark eyes, specialized for night vision, were offset by a conspicuous circle of white hairs. Most interesting of all was the long, pointed,

▼ A FAMILIAR SCENE in the field laboratory: microscopic examination of elephant shrew blood

grooved snout, which the creature moved actively up and down when excited or investigating food.

The elephant shrew appears to most people to be a strange kind of rat. It is not a rodent, however, but an insectivore. Thus it belongs to the most primitive of mammal orders, the same one as the hedgehogs. The species with which we are dealing has recently been identified as *Elephantulus rufescens rufescens.* About 30 forms of the genus are found in Africa and Asia Minor but nowhere else. They range from Algeria to the Cape, but we believe that our species is the most northerly one in East Africa. A few elephant shrews in other families and genera grow almost to the size of half-grown rabbits!

Elephant shrews were seen easily enough at Kapoeta in April, for the clump grass was burned to short, blackened stubble. The rains that cause it to grow taller than a man had scarcely started. Now only low tree or bush acacias and thick clumps of a cactus-like euphorbia grew in the heavy clay "cotton soil." The little animals liked to hide under these or under the highly protective fences which the Taposa make by throwing up the spiny branches around an area they intend to cultivate during the rainy season.

We often saw the animals in the morning and in late afternoon but only seldom during the heat of the day. They were difficult to detect when motionless but were easily startled into running when a person approached. They hated to leave their runways, but if desperate to escape they often disappeared into the long, deep fissures that broke the earth during the dry season.

Groups of four or five Taposa men or boys were able to harry the elephant shrews into a senseless flight that ended in the cupped hands of one of them, and so our first lot of research animals was accumulated. Men earned a week's wages in a few hours; but the British were not disturbed, for they said the situation was so temporary and unusual that it would hardly upset the economy of the tribe.

The Nilotic tribes, most of whom refer to the elephant shrew as *ikabok,* say that they come into their huts at night and that they eat rats. The former story may be true, but with their small teeth and weak jaws we find it impossible to believe the latter one. The natives also consistently say that the animals disappear during the rainy season, but this is undoubtedly an assumption based on the difficulty of seeing such small creatures in the thick grass.

At Torit, about 100 miles west of Kapoeta and about 80 miles east of the Nile, we found a different tribe of Nilotics, the Lotuka. And here we encountered the elephant shrew under very different circumstances. After searching in vain under acacia trees in the grassland, we went farther away from the settlement where there were few if any single trees in the grass. There groups of several trees of different kinds formed dense islands of vegetation. Below the trees were vines and shrubs and a few succulent and herbaceous plants. Outside in the uniform grassland the sun was hot and glaring, but inside the islands of vegetation the temperature was several degrees cooler, and there was little light. Each island might measure from 10 to 30 feet in width and from 30 to 70 feet in length. In these shady refuges we found the elephant shrews.

After we had visited a considerable number of these islands, I came to the conclusion that the islands had been able to establish themselves in the dense grass because of the large termite mounds that dotted the area. When the termite mounds are in active operation, no plant can grow on their hard, sun-baked sides. But when successive rains beat down abandoned mounds, their consistency changes and seeds that fall on them germinate and develop into plants. The chemical characteristics of the soil on these mounds is apparently more favorable for tree and shrub seedlings than for grass, and gradually, as the first intruders grow and produce shade, others are able to gain a foothold. Thus the islet becomes an ever-growing island of dense, heterogeneous vegetation.

The elephant shrew runways in these islands were eagerly pointed out by the Lotuka guides, who had been assigned to us by the Torit District Commissioner, Mr. John Owen. Each of the dozen men and boys carried his own equipment for catching these animals. It consisted of several small bows but no arrows to shoot from them. Instead, they bent each bow into an arc and tied the sagging string into an ingenious noose about two inches from one end.

When all the bows in the party had been so prepared, the men chose one end of a large island of vegetation that showed a number of fresh runways. In each narrow path they thrust several bows upright so that the noose was just above ground level. Now that every pathway was covered, they retreated to the outside of the island and started shouting, throwing stones, and beating the vegetation with sticks. Scared by all the commotion, the shrews fled down their familiar runways and trapped themselves as they reached the nooses. About half of them were instantly killed, but the others were unharmed, and these we placed in cages.

This method of obtaining live specimens worked quite nicely at Torit during the dry season, but when we needed more during the rainy season, we ran into serious difficulties. Our quarry was seldom where we had come to expect it to be. The animals took advantage of the shade and concealment offered by the grass that had sprung up so densely with the rains, and left their dry-season haunts to roam far and wide. Added to this, we had difficulty in getting enough Lotukas to accept the time-consuming job at this season. Normally they divide their activities, hunting during the dry season and cultivating their millet fields and caring for their goat herds during the wet season. As it is, the District Commissioner has to force them to cultivate by sending police and soldiers into the village, and we could hardly assume the blame for subsequent starvation by interfering with his program. So we assembled the few available men

➤ A FAR CRY from the clinical laboratory: natives and their policeman-boss setting out to catch the little animals near Torit

➤ THE BOW AND NOOSE devised by the natives for catching the shrews as they fled down their familiar runways

Harry Hoogstraal photos

and boys, obviously not the most experienced, and offered them huge bonuses. We taxied them to and from the hunting grounds and helped them as much as we could; but the results were always disappointing. Our own live traps yielded nothing but grass rats. At last we were forced to load cages on porters and obtain our animals from a more distant village where the grass was shorter.

That is the story of the capture of the elephant shrew. But the laboratory aspect of our project and the domestication of the animals are another story.

Lawless and I had to find out as much as we could about the malaria that we found in the animals and try to adapt them to cage conditions. One of our first jobs was to determine what they ate and to provide a suitable diet that could be easily and inexpensively offered them in the laboratory.

William Terry photo

We found by stomach examinations and feeding experiments that termites and some kinds of ants were their favorite food, though they did eat some other insects and a small bit of vegetable matter. They could not cope with large grasshoppers, and the shells of some beetles were too hard for them to crush. Other insects must have had an offensive

➤ THE AUTHOR showing a native how to hold the shrew when transferring it from the noose to the cage

Harry Hoogstraal photo

▲ COLLECTING mosquito larvae in tree holes near Torit: Chief Deaner K. Lawless searching for the insect that carries elephant shrew malaria

odor, for they, too, were disdained.

If wingless termites are their "meat and potatoes," fat winged termites are to the elephant shrew what ice cream is to the American child. Whenever the winged termites left their nests, a feast day was proclaimed, for they are also much relished by the Nilotics. The natives have two clever ways of obtaining them. Rain induces the winged members of the colony to fly out, and so the natives imitate the patter of rain by tapping on the side of the termite mound. To make sure of the illusion, they pour a few drops of water down the opening. Then the termites fairly gush forth and are easily collected. Or when natural rain induces the termites to leave, the Nilotics build a fire over a pit dug near the mounds. The termites, attracted by the light of the fire, fall through the flames into the pit and are scooped up to be eaten or sold to the less industrious natives—or to us as elephant shrew food.

Other insects were extremely rare during the dry season at Kapoeta, and we had to depend almost entirely on termites. Large termite nests dotted the landscape, but the inhabitants, living in considerable self-made heat underground, were seldom near the surface or openings, and the sun-baked walls of their castles were most difficult to break into. Another termite, which makes a small domed mound lined with cut grass stems, was more readily obtainable, but we quickly consumed the local colonies.

When quantities of worker and soldier termites or ants were placed in the elephant shrew cages, so many of the insects attacked the animals and attached to their feet, tails, and ears that they cowered in the corner in fright. Wanting to get them started on an artificial diet anyway, we began giving them chopped meat—whereupon almost all died.

It was difficult to fight off depression as—without elephant shrews—we struggled back to Juba over rain-soaked roads in our jeep. After the first day with the rest of the party, our spirits revived, and we blatantly announced that we were sure we could keep the animals alive if given half a chance. After deliberation, the Commander, always a good sport for a challenge, told us to go ahead and try our luck. He headed down to Kenya with his party.

Our second attempt was a complete success. This time we set up operations in two *tukals* (small native-type huts) in the yard of the Juba Hotel and brought our catch in from Torit. Jock Graham, the generous Scotch manager of the hotel, loaned us his carpenter for making cages. He also provided the various foods that we offered the animals in our attempt to determine their preferences, and he helped us in many other ways.

Small children with bug-nets could be seen all over the Juba landscape as they chased the plentiful grasshoppers for our elephant shrews. But we were still anxious to get our charges started on a diet that would be practical under laboratory conditions. Graham gave us small wax-paper dishes, and after some experimentation, each shrew was fed nightly with a dish of oatmeal and milk, chopped meat, chopped eggs, and a "come-on" of live grasshoppers. This is the same diet that later was fed them in the States, except that meal worms were substituted for grasshoppers and termites.

We fed newly-captured animals with milk from a medicine dropper. All but a few were eager to accept this strange food, but they showed little interest in dishes of milk in their cage until taught to drink. We would hold one with its snout almost in the dish and force the dropper into its mouth. As it drank we would slowly withdraw the tube into the dish of milk. The animal would then lick the sides, and finally the milk, from the dish. We felt that they needed this sustenance during the initial period when they were eating but little.

However, we were concerned over the radical departure from their

➤ NATIVE, elephant shrew Gladys Terry, wife of Adm tive Director, University o fornia Navy African Exp

usual diet. Obviously they ingest no liquids during the long dry part of the year when little if any dew falls. The few stream courses are completely dry during this season, and rivers are many miles away. We suspected that some animals that died with distended bladders were adversely affected by the milk, but before we could prove this point one way or the other, they began accepting their new diet and our worries were over.

Chopped meat was always quickly accepted, but some individuals ate chopped eggs while others refused them. None displayed an interest in dry rice, peas, or lentils, though the natives insisted that they did eat grass seeds.

We noted that they refused to eat any food until they had touched and sniffed it with the tip of their long snout. Once they had decided the food was palatable, they might hold it down with one or both forelegs. The head of an insect was always eaten first, then the thorax, and lastly the abdomen.

The elephant shrew is a slow eater and often rests between mouthfuls. But a meal of winged termites was an exception: they were always eaten without a pause. Cage partners often fought over a grasshopper that one was eating, even though several other grasshoppers were only an inch or two away. The males were usually the aggressors in these fights, but a few females dominated their mates similarly. During the daytime they were clumsy about catching grasshoppers in their cages, and several attempts were usually necessary.

Housing our little beasts became a project out of all proportion to their size. It had been impossible to carry cages on the long trek to the Sudan, and materials for their construction were scarce, to put it mildly. Southern Sudanese carpenters are painstaking, but they seldom rush about anything. The easiest cages to construct were simple boxes with tops that could be lifted off. However, we spent so much time chasing escapees that we quickly decided upon sliding-door cages, even though they were slower to construct. Even then, if the wooden door shrank, as it usually did, the shrews used their snouts ingeniously as levers for moving it aside.

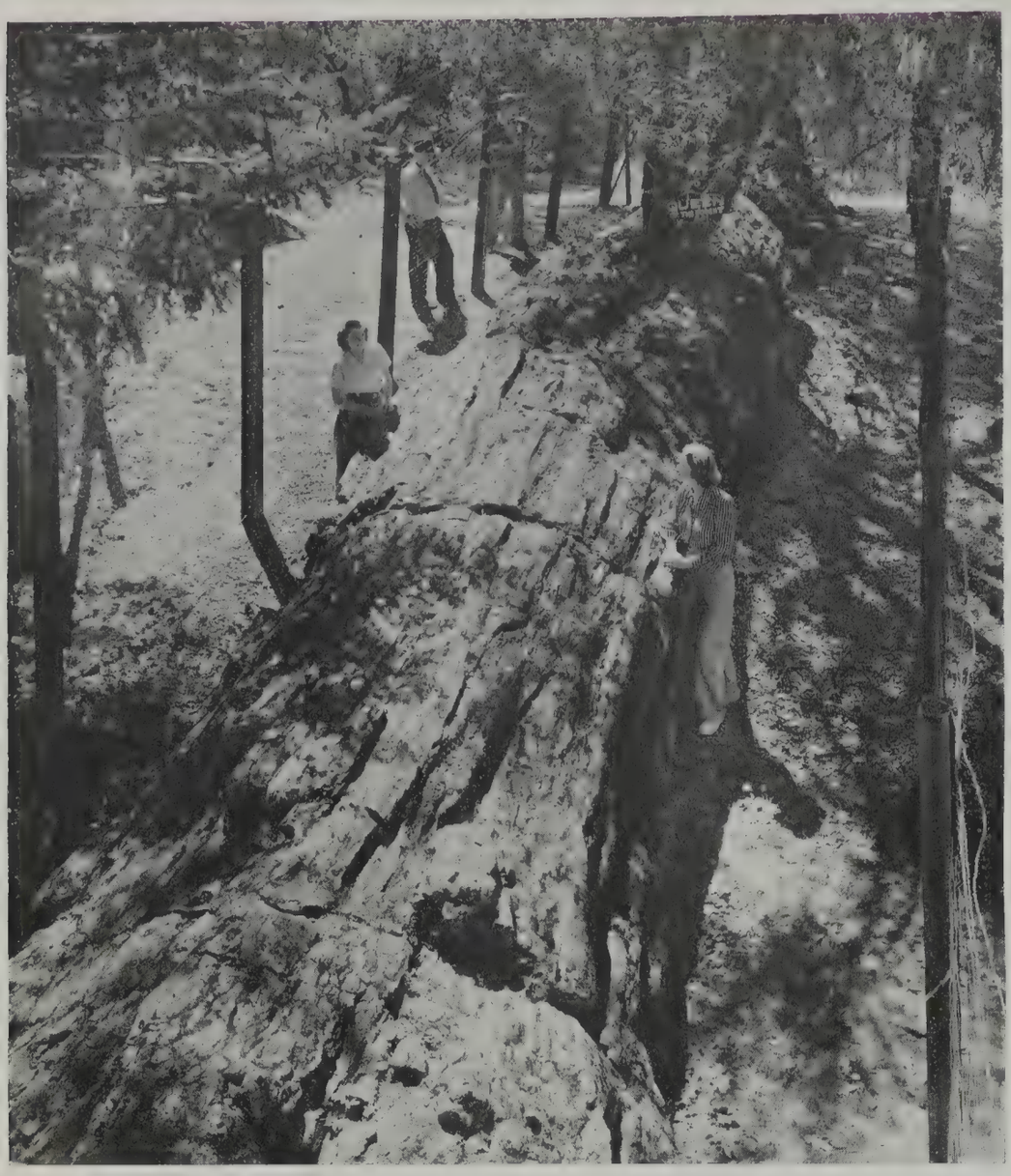
When the elephant shrews escaped from the building, they usually hugged the outside walls and were easily recaptured. A few darted across open ground to a building 25 feet away, but there they stayed and were also easily retaken. One eluded us for two days until a boy chasing grasshoppers saw it, bedraggled and unhappy, in a drain pipe of the near-by building where it had probably been all the time. During the daytime, the fugitives ran on all four legs, but at night they made for their objective directly with great hops on their hind legs, the short forelegs touching the ground only briefly.

When we caged several animals together, they huddled in a pile, and their combined heat changed their sleek fur coats to soggy mats. Their abject fear was caused by domineering males who scratched and bit at any member of the group that dared move. So, as quickly as we could, we obtained enough cages to keep pairs separately. The animals obviously preferred to be with at least one other. Whenever one in a single cage could climb over the partition and huddle next to another animal, it would do so. We noticed that if we removed both from a cage and then put one of them back in

Continued on page 140

Gladys Terry photo

▲ WILLIAM TERRY and the author feeding newly-captured shrews with milk from a medicine dropper. Development of a diet on which the animals would thrive under observation at the Naval Medical Research Institute required considerable experimentation. These are probably the first elephant shrews ever to reach the United States alive



▲ "THE QUEEN" of the petrified giants: one of the huge redwoods that were overthrown several million years ago by a volcanic eruption and then turned to stone

▼ MT. ST. HELENA in California's Coast Range, at whose base the stone trees lie. It was here that Robert Louis Stevenson honeymooned with Fannie Osbourne and wrote *The Silverado Squatters*

STOR

of the R

Millions of years ago thes monarchs met a violent death yet in the strange manner o their destruction they were pre served for all time

By

DOLORES BUTTERFIELD JEFFORDS

Photos courtesy of the Redwood Empire Association

THE scene: the westernmost edge of a great continent. The setting: a forest of giant redwoods, towering to a height of over 300 feet, against the backdrop of a mountain range. The time: several million years ago.

Many of those redwoods had been growing in that kindly soil for some 3000 years. How many thousands of years longer they might have flourished there, no one can say, for the natural life span of the redwoods is still undetermined. So far as is known, they never die—they succumb only to violence, as did these. The mountain at whose base they grew exploded and gave forth ash, mud, and red-hot lava, which spread desolation for miles around over the quaking earth. When the eruption was over, the forest of giants lay prostrate under a vast blanket of volcanic waste.

Thus has science reconstructed the prehistoric drama of Mount St. Helena and the underground petrified forest in Sonoma County, in California's Redwood Empire. Their long imprisonment beneath the volcanic ash transformed the huge trees into columns of siliceous

REES

ood Empire

↑ "THE GIANT," like the other trees in this fallen forest, apparently lost its top before petrification could preserve it

rock. In 1871, the tract was discovered, and gradually since that time a number of the trees have been excavated in an area about one mile long by a quarter of a mile wide.

Unlike other petrified forests, which consist largely of stumps and broken fragments, this one is composed of huge trunks of the largest of all trees, many of them almost entire. Many have been uncovered at a depth of 90 feet below the present ground surface, lying one above another, their tops, with significant uniformity, pointed away from the mountain that destroyed them. Yet, in destroying them, it preserved them for all time—preserved them in stone, with the most minute perfection of bark and grain and even of the growth rings that reveal how many centuries they stood there before the eruption felled them.

GEYSERS, mud-pots, and mineral springs ve evidence of the subsurface activity at caused the ancient cataclysm

The process of petrifaction included a few worms embedded in the wood of some of the trees. And leaf imprints have been found, although the petrified trunks are topless and rootless, as if the extremities of the trees, less completely covered, had disintegrated before subsequent eruptions or the accumulated soil of thousands of centuries buried them more deeply.

The individual trees of this stone forest have names, the most celebrated being "The Queen of the Forest," "The Giant," and "The Monarch." "The Queen" is a tremendously massive column 80 feet long. "The Giant," despite its name, is smaller—56 feet long and 8 feet in mean diameter. Being redwoods, these trees must have been taller; part of their length must not have been fossilized. Both of these trunks are broken into several sections, but there is no displacement to mar the impression of the whole, except that two sections of "The Queen" have been thrust apart by a thriving live oak that has grown between them.

"The Monarch" is the most perfect of these petrified redwoods, having an unbroken length of 126 feet excavated thus far, part of it exposed, part lying in a tunnel dug around it. When fully excavated, it is believed it may be 300 feet long. Its age at the time of the eruption may have been 3000 years.

There are petrified pines among these trees, easily distinguishable from the smaller redwoods by their perfectly preserved bark texture.

Mount St. Helena has long been peacefully extinct. It is a domi-

▲ FORESTS again clothe the slopes of the long-inactive volcano. Today the region is a favorite vacationland, accessible by a network of all-year highways

nant peak of the Coast Range and was named by the Russian settlers who, despite protests of the Spanish government and the succeeding Mexican government, held possession of northwestern California from 1811 to 1841. It was on Mount St. Helena that Robert Louis Stevenson honeymooned with Fannie Osbourne in 1880 and wrote *The Silverado Squatters*. The site of the bunkhouse they occupied on the mountainside is marked by a monument dedicated to the famous author, representing an open book.

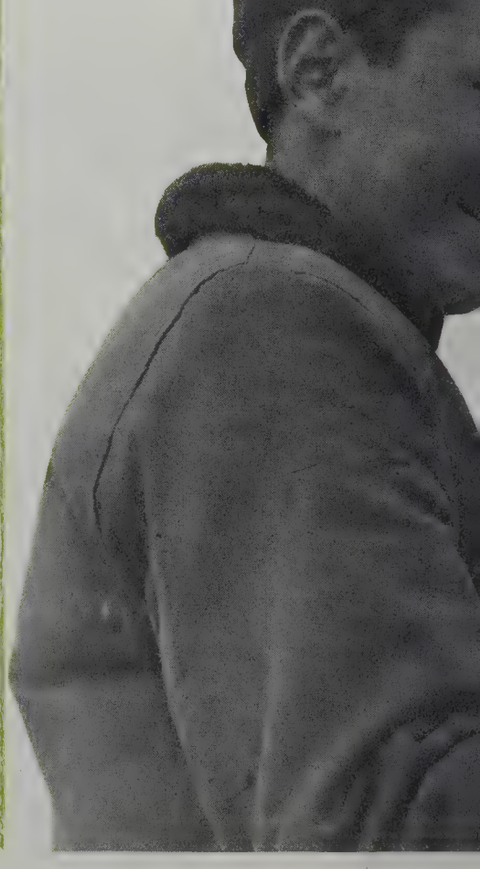
St. Helena is beautiful now. Forests again clothe its slopes below the high, bare peak, and orchards blossom around it. A modern highway winds to the top, where the Russians placed a tablet in honor of their empress. The surrounding area abounds in geysers, hot mineral springs, bubbling mudholes, fumaroles, and other post-volcanic phenomena. And near by is a mountain of obsidian, a mass of black volcanic glass. This is the locale of many health resorts, a year-round vacationland, a place of both historic and prehistoric interest, and a favorite region for scientists to study the continuing thermal activities near a long inactive volcano.

But the outstanding exhibit of the region is the Petrified Forest at the base of Mount St. Helena, on the Petrified Forest Highway, five miles west of Calistoga. How far that buried forest actually extends, how deep some parts of it may lie, will perhaps never be known. Nor can we guess how many other such forests, laid low by cataclysmic upheavals in past ages, may lie in the Redwood Empire under the roots of their towering descendants of today. It is enough that here, imperishable even in death, vastly older than the oldest present redwoods, are giant trees that lived and flourished millions of years ago; trees that for eons of time lay under the earth, to emerge at last transmuted to stone, with lifelike preservation of every mark, grain, and fiber. Here, in the light of another day, infinitely removed from their own, they can only be viewed with wonder and awe and with a profound recognition of the fact that, despite all our scientific advancement, there are still "more things in heaven and earth . . . than are dreamt of . . ."

Sea

THE quartermaster at the wh
nodded in the direction o
dark heavy-bodied bird that vee
sharply into the twenty-knot bre
to miss the "Penguin's" pilotho
and skim heavily over her spr
drenched bow. "That bird is a
parrot," he volunteered, "but t
can't talk," he added, with the
of one who has been disappoint
"All they can do is bite, and t
do that mighty well. Better not
one get ahold of your finger or h
pretty near take it off." I didn't
terrupt him to say that to landl
bers the bird is known as a tuf
puffin, since to sailors all puffins
"sea parrots."

We were aboard the motor s
"Penguin" on her May trip to
Pribilof Islands. Five times a y
she makes the 5,000-mile round
to carry supplies from Seattle
the fur seal islands in the mid



arrots

ome birds stand to lose more than eathers during the postnuptial olt. Take the puffin, for example

By KARL W. KENYON
U. S. Fish and Wildlife Service

All photographs by the author

▲ TWO SPECIES OF PUFFINS are abundant on the Pribilof Islands. The tufted puffin, shown here, is all black, except for its white face and ear tufts, whereas the horned puffin is white underneath. Puffins appear to prefer the company of their own species

of the Bering Sea. As we rolled and pitched through the rough, dark waters of the Bering, still over 100 miles from the Pribilofs, two species of puffins frequently skimmed near us over the choppy sea or rode like jaunty corks on its surface. Sometimes those swimming in our path turned sharply into the wind and, bouncing from one wave crest to another, finally lifted their chunky bodies on rapidly beating wings into the gusty wind. Others, with apparently no intention of actually becoming air-borne, simply folded their bright orange feet back across their rump, as if to get them out of the way, then hydroplaned over the surface on their bellies, using their wings as giant oars, until they were well clear of the ship.

"Even at a distance you can tell the two kinds of sea parrots apart," the sailor went on. "One is white underneath and the other is all black, except for his white face and ear tufts."

The sailor referred to the two species of puffins found in the Pacific and Bering Sea, the dark-bodied bird being the tufted puffin and the one with the white underparts the horned puffin. Puffins are characteristic of northern seas. Like other members of the auk family, they are circumpolar in distribution and seldom venture south to warmer waters. An Atlantic species ranges from the Arctic southward to the British Isles, the coast of Maine, etc. It embraces three geographical races, but they are indistinguishable in the field.

The tufted puffin enjoys a wider breeding range than any other bird found nesting on the Pribilofs. It nests on many of the small islands along the west coast as far south as Anacapa Island off Southern California. The horned species, like its relatives in other northern seas, is confined to more northerly areas and nests only on the islands of the Bering Sea and along the coasts of Alaska and Siberia. Even in winter, few of them venture south as far as California. Dead specimens have been picked up on the beaches of Southern California, but these birds were probably storm-driven individuals that became weakened by heavy winds and seas, finally to wash ashore south of their normal range.

Other sea birds besides the puf-

▼ THE AUTHOR'S valuable Aleut assistant, Lavrenty Stepetin, who knew how to handle puffins and had due respect for their strong, sharp bills. The birds are well aware of the strength of their bills and inflict painful cuts if carelessly handled

▲ PUFFINS are sociable birds; they often gather in groups, as shown here, to enjoy the company of their neighbors

➤ BENNY MELOVEDOV, an Aleut boy of the Pribilof Islands, holds a puffin chick. Although the young puffin used its bill on fingers that came within reach, it was not strong enough to inflict cuts, and it lacked the aggressive attitude of an adult puffin

fins were often about the ship as she plowed doggedly through the tossing seas toward the north. Half a dozen glaucous-winged gulls had followed us from Unalaska, in the Aleutians, and an occasional kittiwake passed at a distance, ignoring and aloof. Least auklets and crested and paroquet auklets sometimes took wing, more lightly than the heavy puffins, or hurriedly dived as our bow broke water near them.

Puffins are frequently noticed by sailors because of their heavy, strikingly-colored bill and relatively large size (about that of a large pigeon). "I found one in a hole on a little island in the Aleutians where we stopped a couple of summers back," the quartermaster continued, "and when I put my hand in to grab him, he grabbed me instead." He held up his right index finger to display a long white scar line just below the fingernail. "I bled like a stuck pig and haven't bothered sea parrots since." Unlike the bills of hawks and owls, which are relatively weak, the bills of such fish-eating birds as the puffin are strong grasping devices.

Later in the spring I had an opportunity to dig a puffin from its burrow and, remembering the sailor's experience, wore a pair of heavy gloves. The burrow was about four feet deep. About halfway to the enlarged chamber, where the single egg rested, it turned rather sharply to the left. When I had reached this point, the puffin decided to make a dash for freedom. As I grasped the escaping bird, I found that I had been wise to heed the sailor's misfortune. Even through heavy gloves the strong, sharp cutting edges of the puffin's bill dealt me several hearty pinches. Puffins are well aware of the power and effectiveness of their bills and when handled make every effort to use them.

Besides acting as a useful weapon of defense, the bill is employed in the excavation of the burrows in which these birds nest, and its razor-sharp edges serve well in their fishing activities. The brilliant colors of the bill are part of the puffin's nuptial adornment. Both sexes are marked alike, and during the breeding season the bill of the tufted puffin is largely a brilliant red-orange, with a pale waxy-green area at its base. That of the horned puffin is a pale lemon-yellow, tipped with shades of red. At the corners of the bill, a leaf-shaped wattle of flesh protrudes. This is crimson in the tufted puffin and yellow-orange in the horned.

After the breeding season has

A PAIR of horned puffins carry on their courtship at the entrance to their summer home in a basaltic Pribilof cliff. The birds sit for hours on such perches, caressing each other with their bills

THIS HORNED PUFFIN stands posed for a few seconds to stretch its wings before gliding away into the strong sea breeze that sweeps up over the face of the cliff

passed, the puffins lose their spectacular bills. In the late fall, the bill plates begin to loosen at the edges and scale off. The new bill, which is revealed as the sheath of the old one falls away, is smaller and duller in color. The bill plates are shed at the time of the postnuptial molt, when the tufted puffin also loses its streaming breeding plumes and retains only a few little white wisps behind the eye for the modest adornment of its winter dress. The white face, too, disappears and is replaced by dark feathers, so that as winter approaches, the adults take on much the same appearance as the young birds during their first winter.

Puffins range far at sea during the winter months and seem at home on the high seas even during the stormiest weather; yet they appear equally contented when they gather on wind-swept island cliffs during the summer nesting season. They begin to arrive in May, and you see numbers of them flying along the cliff edges or resting on the rocky projections and ledges to carry on their courtship. When a human intruder visits their nesting cliffs, their curiosity is aroused and they circle close by time after time, retarding the speed of their flight as they glide in on the strong upwelling wind that sweeps from the sea and rises abruptly against the face of the cliff. With necks stretched and orange feet spread to steady them, they stare inquisitively for a few seconds and are then off again for another circle. In the early spring the Aleuts take advantage of the natural curiosity of the puffins, as they do of the smaller auklets, by catching them for food in long-handled nets or by knocking them from the air with sticks.

Wild creatures must face many tests of their fitness to their environment. Thus, when we find a defective individual that survives these hardships, we cannot help wondering how he succeeded. In the summer of 1947, I found a tufted puffin handicapped by a blind eye. The bird was resting on

▲ PUFFINS SELDOM WAIT long enough to give a photographer a chance for a close-up like this one. Usually they launch themselves into the steady breeze, their bright orange feet spread as stabilizers while they gather speed. Then they circle back and take a close look at the human intruder

a rock that projected from the cliff, and from the edge of the cliff I could look down on him only a few feet away. Since his bad eye was turned toward me while he watched the circling birds near by, I was able to approach closely without frightening him. Apparently his eye had been injured by some accident or was affected by disease, since it was covered by a heavy, opaque membrane. To have found a one-eyed bird was not so strange. However, I was somewhat surprised when the following summer I found the same bird seated in precisely the same position on the same rock. He was undoubtedly a wise old bird that had weathered many seasons. He had the look of age about him. Although he seemed in good condition, his feathers were less sleek and glossy than those of near-by puffins, and he seemed a lonely fellow, apart from the others. I looked again for him last summer, but he failed to appear on his old perch. Apparently his blindness, coupled with old age, worked too strongly against him in the stormy winter of the northern seas.

For their nesting places puffins choose natural cavities in broken rocky cliffs or excavate a burrow in soft island topsoil. Although horned puffins prefer the faces of cliffs, the tufted ones often honeycomb loamy island slopes with their burrows. On such islands they dot the hillsides like tiny sentinels, sitting bolt upright near the entrances of their homes. Where foxes inhabit their nesting islands, as they do on many of the Aleutian and Pribilof Islands, both species are limited for safety's sake to cliffside nests. Aside from the labor of excavating, the puffins trouble themselves little over the details of nest building. The burrows that I have looked into contained only a careless scattering of grass stems or a few large feathers. Judging from the bedraggled appearance of these feathers, the birds must have found them floating on the surface of the sea. I have seen puffins returning to their nest holes from the sea with a primary feather of a gull held crosswise in the bill, in the same manner that they bring fish to their young.

The single egg is a lusterless white, faintly marked with varying amounts of pale brown and violet. It is large in proportion to the size of the bird, as are the eggs of other members of the auk family. The chicks hatch well covered with dull gray down, and their eyes are open and alert.

Puffin chicks make friendly and comical pets. They tame rapidly and are greedy eaters. The difficult part of securing a puffin chick for a pet on the Pribilofs is getting it from its nest. This is only possible through the use of a long rope and enough nerve to lower oneself down over a crumbling cliff edge. One afternoon I decided to make such a climb and found that locating a young puffin was one thing and extracting it from its hole in the rocks another. After looking into a number of deep and dark but empty crevices, I suddenly caught a glimpse of a ball of down well back in a dim recess. The little bird had no desire to leave its

▼ WITH THE AID of their strong bills, t puffins dig burrows in the soil three or feet deep. Where foxes and other pred animals do not force them to use the cliffs, the puffins honeycomb the topso the islands with their underground h They lay a single lightly marked or n white egg

cozy quarters and scampered back to the darkest corner, where it turned a truculent, beady eye in my direction and refused to move. Since it was well beyond the reach of my arm, I shouted instructions to my helpers above, and a long-handled net came down over the cliff at the end of a line. With this I succeeded in introducing the young puffin to the light of day.

It proved to be a tufted puffin and once in hand appeared quite contented and interested—mainly in fingers, which it apparently mistook for tasty bits of fish. We found later that the young bird could consume at one sitting a handful of chopped fish equal to nearly half its own bulk. Even when full to capacity—to the extent that as it opened its bill to chirp for more, the last piece eaten threatened to escape—it seemed anxious to try to pack in still another morsel.

THE DARK SEPIA BILL of this young fted puffin shows little resemblance to e massive orange one of its parents. ffin chicks are gluttonous. This one con-ued to beg for fish scraps even after it as packed to the point of spilling over

On rare sunny Pribilof afternoons when I found myself free of other work, Lavrenty Stepetin, an Aleut boy interested in my work with birds, would help me round up my equipment, and we would go out along the cliff tops to locate photographic subjects. Lavrenty has spent most of his life on St. Paul, largest island in the Pribilof group, and was always a welcome assistant on such field trips. On these sunny afternoons we found the sociable puffins relaxing on the rocky projections of the cliffs near their nest holes. They enjoy the company of their neighbors and sit for long periods watching the host of murres and kittiwakes streaming back and forth between the cliffs and fishing grounds. It would not seem a difficult task to locate these resting birds, then lean out to take a photograph. However, the puffins are often quite wary of human visitors and usually glide away toward the sea, preferring to circle back to take in the situation from an aerial vantage point. Thus it was usually necessary to stalk carefully through the tall rye grass at the cliff edges, and Lavrenty proved a very able helper in securing the photographs accompanying this article.

In late September and October, most of the murres and small auklets have led their young away to the sea before the puffins leave their nesting cliffs. Not until harsh storms are lashing the Pribilof cliffs with a fury of wind and wave do the hardy puffins sever ties with their summer home and go to the open sea for six or seven months.

Snowflakes swirled about us as the "Penguin" turned her bow away from the Pribilofs and headed toward Seattle.

"Where do all the sea parrots go in the winter?" asked the sailor who had told us of his experiences with the birds a few months earlier. A drab brown bird paddled hurriedly away from our starboard bow, and I pointed it out to him. "Well, I'll be darned. I've heard of birds losing their bright feathers come winter, but this is the first time I've ever heard of a bird changing its bill, too. I wonder if they bite as hard with that little winter bill as they do with the big summer one," he mused.

▲ THE SO-CALLED "HORN" of the horned puffin is really not a horny structure but a projection of erectile tissue attached to the upper eyelid. It is raised when the bird is alert. The large bill, besides acting as nuptial adornment and an effective instrument for catching small fish, proves useful in excavating the nesting burrow

▲ VISITORS TO Hancock Park look at the stagnant pond that was a death trap for great numbers of prehistoric animals

TAR

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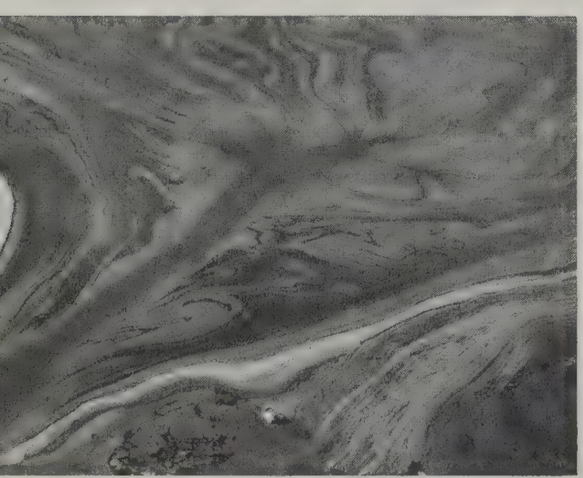
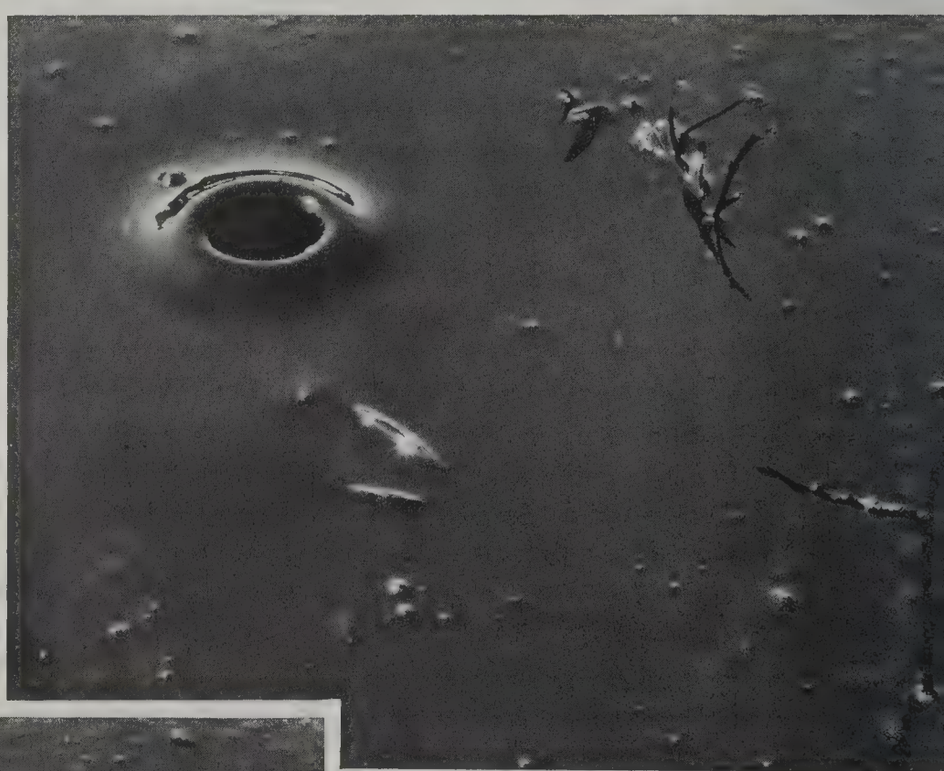
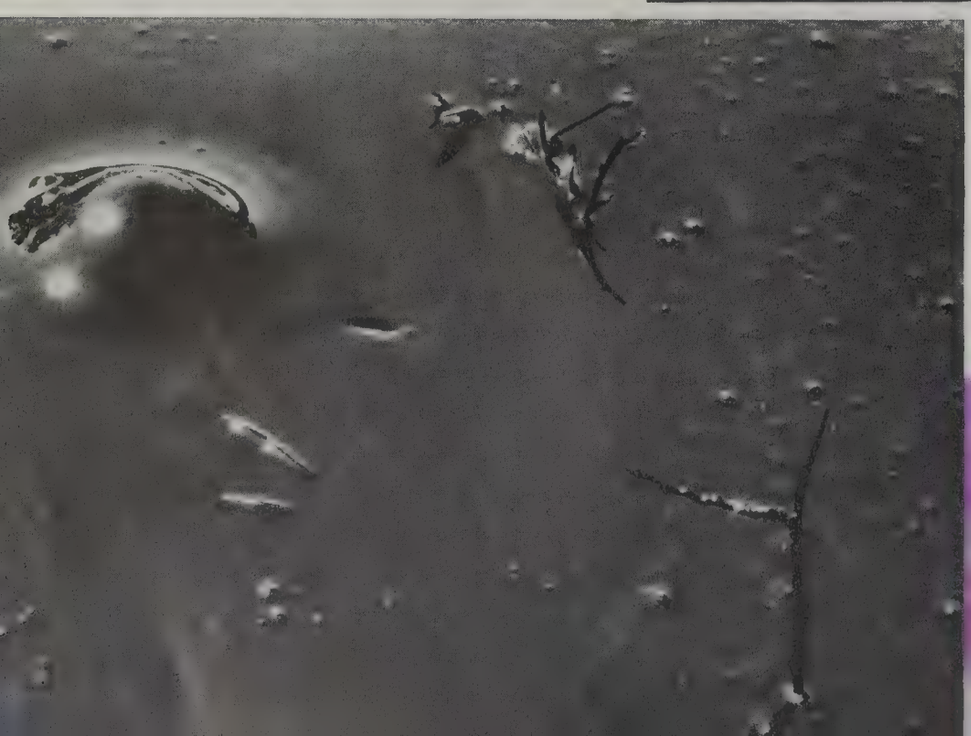
▼ OIL SEEPS continuously from the tar (bottom of picture) and flows out in streaks across the surface of the water





▲ THE BUBBLE has b
and the surface is flatt
ing out

◀ A BUBBLE rising in the soft tar reaches the surface. The twigs have been trapped in the tar



RAP

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IREY

Amid the ultrasophistication of the twentieth century, scenes of 50,000 years ago depict the animal life of a vanished era at the world-famous tar pits in Los Angeles

NOT all the strange goings-on in Los Angeles are of human origin. In one of the city's blocks the earth itself acts bewitched, or at least pixilated. Tar and oil continually seep from below the surface in a weird display of bulges, bubbles, streaks, and slicks. The place is called La Brea—Spanish for "the tar." The block is surrounded by stores, office buildings, and apartment houses but is itself kept as a public park—Hancock Park—not only because of the strange attributes already mentioned but also because of what has been—and in the future still may be—excavated from its tar.

For, back in prehistoric times, animals (many of them species now extinct) wallowed in the tar, got stuck, and died there. The flesh decayed, but the bones remained. Scientists have already dug up great quantities of them. Complete skeletons have been assembled and are on display at the Los Angeles County Museum. Under the direction of Dr. Chester Stock, who is the museum's Director of Science, Mr. George Kanakoff is soon to start digging again, seeking more bones and more knowledge. The new excavation is to be left open as a permanent exhibit that will show the public how the bones are found.

The fossils already obtained make up a unique collection, famous among geologists, for they comprise the world's largest assemblage of vertebrate Pleistocene animals. Yet many people who live near La Brea know little or nothing about this amazing place. It has not yet been subjected to much modern im-

THIS MASS of bubbles, the most con- s one is growing rapidly. It reflects and the surrounding trees and fence

➤ THROUGH THE HOLE in the center the bubble has burst, and its shell, which apparently had become somewhat hardened, has collapsed

Mural by Charles R. Knight in the American Museum, AMNH photo

▲ A MASS OF BONES exhibited in the jumbled fashion in which they were found when excavated

provement. The ground is uneven and dotted with scattered, uncultivated plants and with a few ponds of stagnant water. They look much like any stagnant ponds, but on close inspection you can see the tar and gas coming up through the water and along the shores.

Occasionally a sound of loud bubbling will attract the attention. It is gas escaping suddenly from below the pond, leaving small water bubbles on the surface and starting concentric circles dancing across it. In the same spot, tar is coming up. It comes in shafts or ribbons, fairly vertical until they reach the surface, where they float and weave like weathervanes as the water current (the slight, vacillating, wind-caused current of a stagnant pond) may turn them. Purplish, oily scum floats off from the tar and across the pond.

Around the edge of the pond there is more tar. Much of it has hardened, but some of it is still fluid and active. It slowly rises in a small mound. The mound forms into a black bubble. There are other bubbles near it which have not changed noticeably in size. But this bubble grows larger and larger, keeps growing for a minute or two —and then suddenly it bursts. The others remain; this one has paid the price of ambition. The gas has escaped; the tar sinks back into a sort of small crater and quickly flattens out.

The oil and tar and gas originated in layers of rock that, even in Pleistocene times, were ancient and far below the surface. The earth pressed down upon the oil and tar and gas, which oozed out on the surface. During the Pleistocene period, the oil and tar formed large pools, some of them many square feet in area and extending to depths as great as 30 feet. The tar, exposed to the air, hardened, and soil has since blown or washed over most of it. But when it was exposed in large pools, many animals were caught in it. Some may have wandered that way purely by chance; others came to drink the water which, then as now, collected in the depressions of the soil. Dr. Stock has written, "It is not difficult to visualize some of these Pleistocene catastrophes. A single animal, large or small, becoming mired in the tar would as a result of its struggles and cries lure others to the trap. The carnivorous birds and mammals seeking to reach this bait would frequently fall victims to the tenacious grip of the viscous material and thus in turn would serve to attract still other creatures to the pool." Dr. Stock explains that the excavated fossils contained preponderant numbers of predatory forms and also many young, aged, and maimed individuals. Animals that couldn't take good care of themselves were at a special disadvantage at La Brea.

Although the tar now covers much smaller areas and is less active, it is still said to be a danger to small animals such as ground squirrels; indeed, the museum has on exhibition the body of a bird mired in the tar. But such tragedies are now rare. On several visits to La Brea, I did not find a sign of any animal caught in the tar, though leaves and twigs illustrated how creatures would stick and sink in it. The tarry depressions are now individually surrounded by high wire fences.

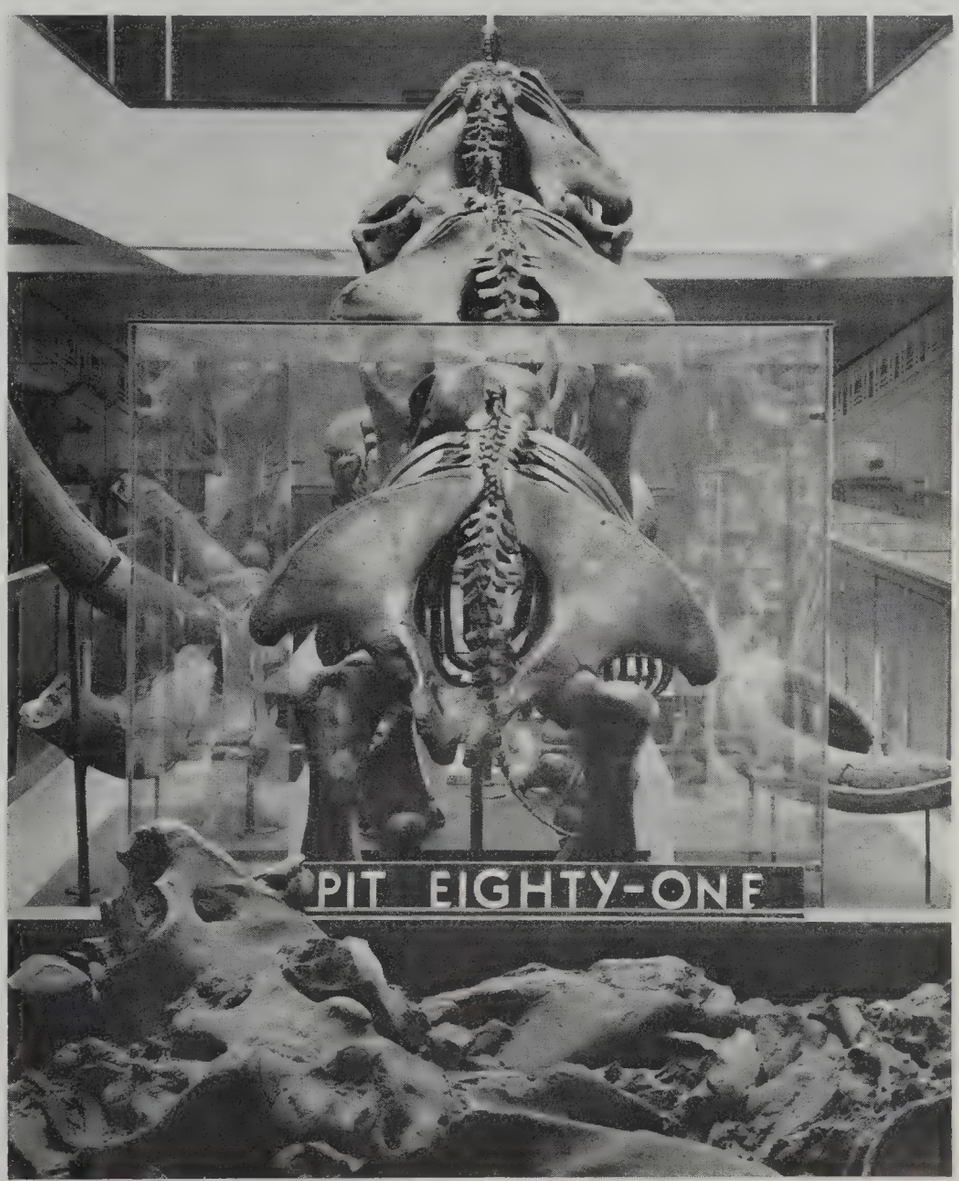
Though these depressions seem weirdly primeval, most of them are the work of man, being the holes left after excavation. Now man—in the person of the Los Angeles County Museum—is giving a face-lifting to the surrounding plain, at least to the block that the growing city has not already eaten up. He has felled trees and scraped the ground bare. He has erected concrete statues of Pleistocene animals and has built two modernistic comfort stations. He promises 55,000 square feet of paved walks, a complete lighting system, and stream and lagoon construction. He prom-

ises also "an elaborate landscaping scene to simulate as far as possible" the setting as it was when the ancient animals were trapped. This means more vegetation, for it is believed that the climate was not so dry then. Many types of trees and shrubs that lived here then are still found in other parts of California and can be made to grow here again by cultivation. Some time further in the future, a new museum is to be built in the park (the present museum is many blocks away), and the present statues are to be replaced with better ones.

Let us hope that the result will not look like just another city park, hiding the primeval burpings of the tar or inharmonious with them. Perhaps the skill of man, and a $738,400 project, are necessary to make a modern wilderness look like an ancient wilderness. Especially with paved walks and comfort stations. We must wait and see.

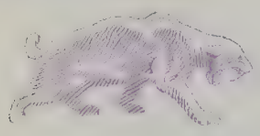
We can already see, in the museum exhibits, a sample of what the excavators dug up from the depths. They made such huge hauls that much of the material is not on display; there are boxes and boxes of bones stored in the basement, with one discarded skeleton perched eerily on top of them. More than 180 different kinds of animals and plants have been recovered. Of mammals alone, more than 4,000 individuals are represented in the museum's collection. When the excavators dug down into the tar to see what they could see, they found bones distributed quite irregularly. In some areas there would be few or none; in others there would be amazingly dense collections. One such jumble of bones is mounted as an exhibit in the museum.

Nature was kind to the scientists not only in the quantity of animals trapped at La Brea but also in the quality of preservation. Although the softer tissues disappeared, the harder parts remained intact. Limb bones retain many surface markings, indicating the courses of nerves and blood vessels and the places where tendons and ligaments were attached. Teeth show the wear their owners gave them. Some bones and teeth exhibit the effects of injury and disease; there are fractured bones that had healed. While the tar preserved the bones that sank within it, some did not sink until they had been gnawed on. In these cases, the marks of the gnawing were preserved—and the scientists can tell which were made by carnivores, which by rodents. Other bones remained exposed to the atmosphere for some time be-



← HANCOCK HALL, Los Angeles County Museum. Reconstructed in the foreground is a prehistoric elephant. The original tusks of this specimen were not recovered, but duplicates were fabricated. The painting in the background by the famous artist Charles R. Knight shows his conception of La Brea in Pleistocene days

↑ AS IF ARISING from the confused bone-pile in the foreground, the skeleton of an immature mastodon ambles away. Ahead of it is a mature mastodon and beyond that an elephant



▲ HEAD of a saber-toothed cat. The lower jaw closed between the large canine teeth

fore sinking in the tar. They show the same effects of weathering as do modern bones lying on the western plains. In some cases there is another type of wear: the bone-laden tar apparently shifted so much that the bones were scratched.

Some of the bones are enormous. They came from enormous animals: the elephant skeleton mounted at the museum measures eleven feet, seven inches to the top of the skull, and the skull itself is nothing to toss lightly around. But the tar also preserved many small things for the painstaking scientists to recover. In some skulls, the tiny bones of the inner ear were intact. Seeds and cones and even leaves have been found; fragments of insects have been identified. The smallest exhibits in the museum's collection are mounted on microscope slides. Some of them may be hair. Miss Gretchen Sibley, a member of the staff who is working for her doctorate, is examining longitudinal and latitudinal cross sections as well as casts and molds, hoping to learn more about what the cautious scientists at present refer to as "material resembling hair."

Among La Brea mammals, flesh-eaters form a large majority. If they had occurred in the same proportions over a large territory, they just wouldn't have had enough flesh to eat. Of course, they came to the tar pits to feed—and stayed to die. Of these carnivores, most belong to the dog family (wolves, coyotes, and foxes) and the cat family. There are also a few bears and other forms.

Of the cats, the most frequent and the most amazing is the saber-tooth. Its two dagger-like canine teeth make even a skeleton look ferocious. This animal was of about the size of an African lion. Unlike the lion, it was not fleet-footed but depended for its food on its ability to grapple and fight at close quarters. Not that any witness has described such a fight; the last of these creatures died before recorded history began. But scientists can deduce an animal's habits from the shape of its bones. Light hind limbs and strong front limbs indicate a fighter, not a runner. The rib basket and breastbone bear out the contention. And those teeth—well, here's how Dr. Stock reconstructs the past: "In attacking a large mammal like an elephant . . ., the saber-toothed cat would probably seek a vulnerable spot on the body or neck of its prey, grip the victim with its powerful front limbs and claws, and repeatedly stab with the upper canines, thus inflicting a jagged wound. In this attack the lower jaw was capable of swinging downward, giving a considerable gape to the mouth, the powerful head and neck muscles furnishing at the same time a strong thrust

▼ LEFT FRONT FOOT of a prehistoric elephant that once roamed near the heart of present-day Los Angeles

▲ ALL of its relatives have become extinct in North America since the day when this camel scanned the California landscape

◀ HEAD of a bison

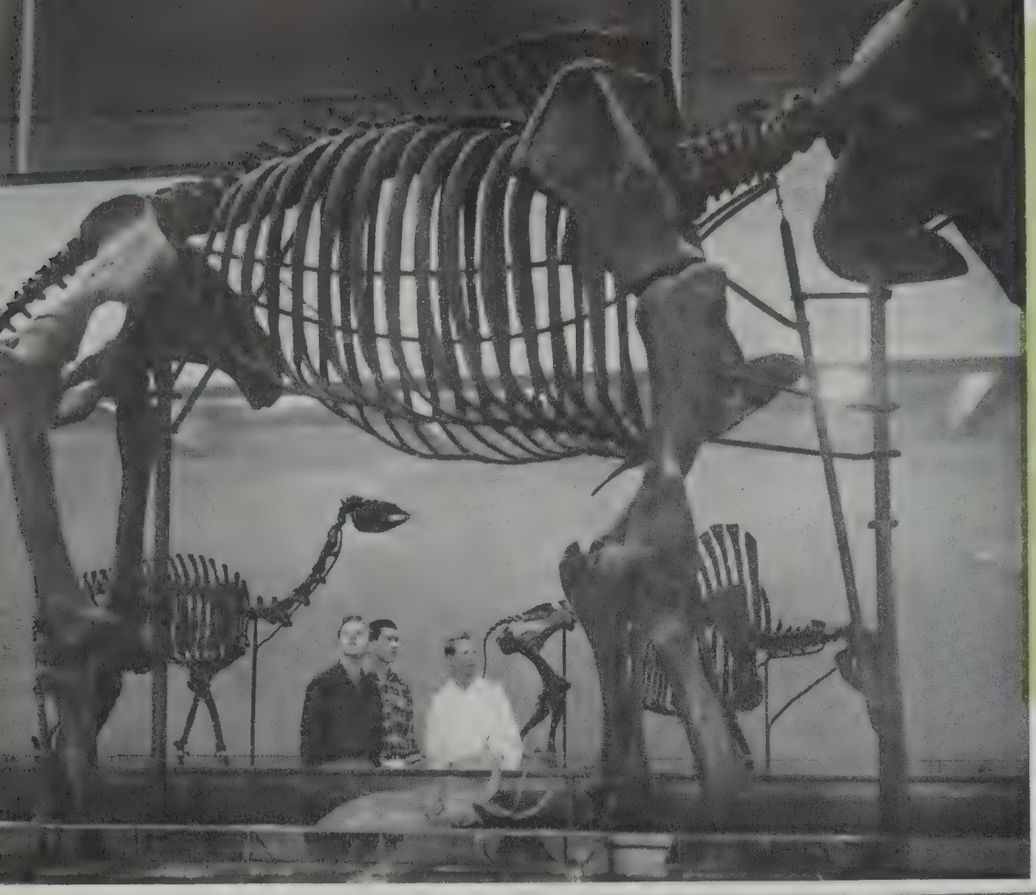
which accompanied the stabbing action of the teeth. The backward position of the nasal opening presumably permitted the animal to breathe with head plunged deeply into the side of its victim . . ." Occasionally one or even both of the saber-like teeth would be broken. Their broken edges, now recovered from the tar, are worn smooth, showing that the cats continued using them after they were broken. The cheek teeth of such individuals also frequently show excessive wear, suggesting that the animal found greater need for them after the canines were damaged.

So much for the carnivores. The other mammals are fewer but in many cases larger. The elephant is largest—larger indeed than the elephants now living—and adorned with huge tusks. Next in size is the mastodon, whose tusks are small by comparison. There is also an extinct bison, larger than the modern North American buffalo and having, like it, a forward hump on its back and horns on its head. There is a horse, which evolution had brought to the size of the modern horse and to one-toed feet. However, it was of a different species than horses now living; horses, like elephants, became extinct in America before the coming of the white man. Camels also became extinct on this continent, but one species is represented at La Brea. It presents a problem the scientists haven't been able to solve. They've reconstructed the skeleton of an entire camel—two, indeed—but the bones give no indication of whether or not the animal had a hump or humps. For, unlike the skeleton of a bison, the skeleton of a camel does not extend up into its hump.

Three of the other skeletons are of ground sloths. One is mounted erect on its hind feet and heavy tail. This isn't due to somebody's whim or an offhand guess. This time the bones did tell a story. The pelvis has a shelflike projection over the hip socket to support the weight of the erect body. The tail bones show that the tail was large, so that the sloth could use it for support and balance, as a kangaroo does. This is the paramylodon, or giant ground sloth. Beside it is another of the same species, this one mounted on all fours, showing how the animal looked when walking. Ahead of the two paramylodons is a nothrotherium, the smaller ground sloth. It is also on all fours, because it had a weaker tail and no projection over the hip socket and presumably could not stand erect.

Birds of about 115 different types have been recognized in the La Brea material. They are a rare find for paleontologists, since the delicate bones of birds are not preserved except under most favorable conditions. There are many predatory and scavenger types, presumably attracted by the animals trapped in the tar. There are also a few aquatic birds, presumably attracted by standing water. The birds vary greatly in size. Teratornis, an extinct vulture, is recognized as the largest known bird of flight; it stood two and a half feet high and had a wingspread of at least twelve feet.

Don't ask about dinosaurs, just because La Brea is full of fossils.



◄ VISITORS VIEW the skeleton of an elephant. Below it is a plaster model of the same species as it probably looked in life

▼ SCHOOL CHILDREN are awed by these giant specimens, as Miss Gretchen Sibley, museum lecturer, describes their interesting characteristics

La Brea animals lived in the Pleistocene period—and that's not very long ago, geologically speaking. Dr. Stock's latest opinion is that the animals were trapped in the tar from about 60,000 to about 40,000 years ago. And the dinosaurs all died long, long before that.

Various parts of plants have been recovered and identified, wood being the most common. An unusual find was the upright trunk of a conifer. It was eight feet high (above that it had burned or rotted away) and was rooted in the clay, twelve feet below the present ground level. The trunk was surrounded by clay, sand, and asphalt and by a dense mass of bones and skulls, all of which had obviously inundated it where it grew.

During the excavations, a human skull and a few other human bones were found. They were close together and clearly belonged to one individual. The construction of the bones indicated it was a woman. The shape of the skull, with high cheekbones, mark her as an American Indian—a modern type, from a geologist's point of view. The other animals represented in the same excavation indicate also that nature operated this particular booby trap in the geologic "Recent," not, like most of the pits, in the Pleistocene. The woman may have lived thousands of years ago, but not tens of thousands.

A few indications of man's presence were found in the other and more ancient excavations, including parts of atlatl darts. So perhaps human beings of some sort were around to see the ancient animals wallow and die; but if any of the Pleistocene people were careless enough to get stuck, the fact is still a secret of the tar.

But what of modern times? How was this natural phenomenon discovered? In 1769, Gaspar de Portola saw "extensive swamps of bitumen," and debated "whether this substance, which flows melted from underneath the earth, could occasion so many earthquakes." In 1792, Jose Longinos Martinez wrote of the "great lake of pitch" in which animals had been seen to sink. He said that trapped animals were a source of game for the Indians and that bones of animals lost in the tar came up years later. In the 1860's,

'70's, and '80's, the tar was dug up for use as roofing, paving, and fuel. The diggers came across many bones but tossed them aside in disgust, especially when the quantity made further commercial use of the tar impractical.

Along about 1905, scientists became interested. They've been digging off and on since and have made 100 or so excavations in various parts of that city block. Sometimes they didn't even find bones. Sometimes they did, and kept finding them as much as 50 feet below the surface. When they were through digging, they usually filled up the hole again. In a few cases, they did not fill it up all the way but left the depressions where the action of the tar may now be seen.

Well, after they'd dug something up, what did they have? A mess. A tarry mess. First thing was to get rid of the tar. So they immersed lumps of the material in vats of heated kerosene, supporting the lumps on a three-quarter inch mesh screen. Thus they removed and cleaned the large bones. Until recently, anything small enough to fall through the screen was lost—thrown out with the tar in a refuse dump. But the dump was preserved; and in 1947, Dr. W. Dwight Pierce and Mr. Kanakoff began recovering the small pieces by means of a Soxhlet apparatus, which held the tarry material in a filter cup. Hot benzine dripped over it, removed the tar, and was siphoned off. The objects that remained, many of them very small, were sifted through a series of screens, sorted, resorted, and studied.

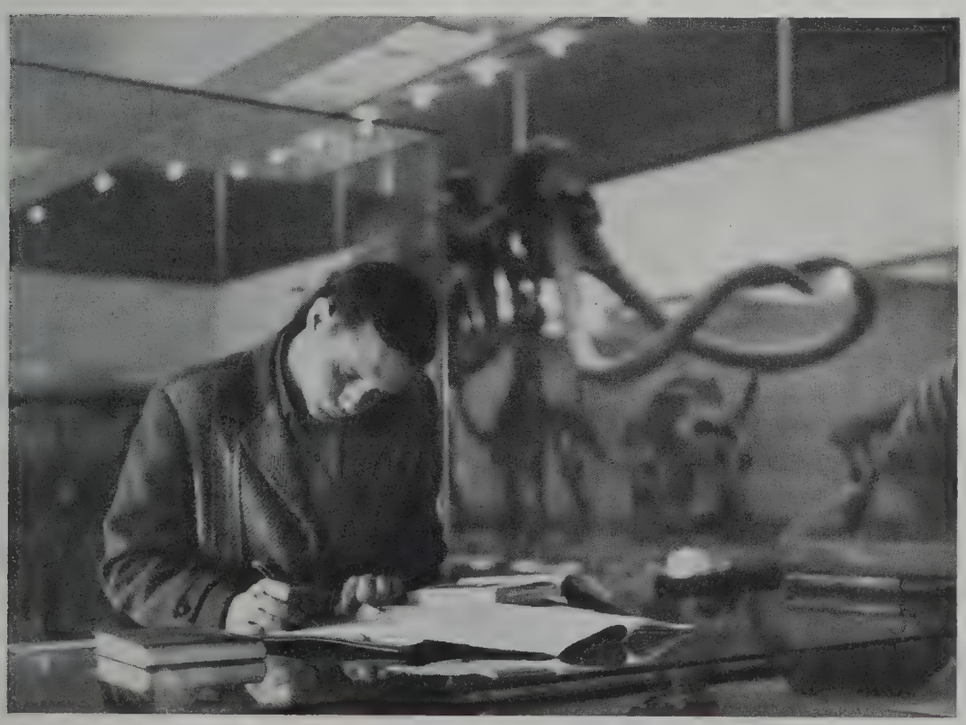
As you may have gathered, the experts are quite clever at identifying the various parts. There are even specialists for different types of material. The late Dr. Roy L. Moodie has written about the ancient evidences of disease among the La Brea specimens. The late Dr. John C. Merriam and Dr. Stock brought La Brea its scientific fame through a book about the great cats. Dr. Alden Miller, Dr. Loye Miller, and Dr. Hildegard Howard have written books about La Brea's birds. Dr. Ralph W. Chaney is still working on the plant material.

When enough bones of one kind of animal are assembled, they may be set up as a complete skeleton. Most of this work has been done by Mr. Eugene Fisher, recently retired. In some cases, the bones of one individual animal were found close together in the tar; indeed, the museum has not only an adult mastodon skeleton but a young one trailing right behind it. If there are a few bones missing, the scientists make artificial replacements, which blend unobtrusively with the genuine parts but do not deceive a careful, trained observer. If there's a bone left over—well, as yet the museum personnel has resisted a strong temptation to give one of the skeletons an extra bone to carry between its jaws.

Hancock Hall, which contains the tar-pit exhibits, is large enough to give them space to be seen. Museums nowadays know something about effective display. The huge skeletons march behind each other like some fantastic circus parade. They are dark brown, since no amount of cleaning can remove the stain of the tar, which has penetrated the hardest layers of bones and teeth. The skeletons are silhouetted against a plain, light-toned wall.

The place is open to the public, of course, and people of all sorts wander through for a look. Almost any morning of a school day, two or three classes of children will have sessions with the fossils. Their regular teachers come along too, but the museum supplies its own speakers. Occasionally a group of older students will spend a few hours of research in the room, reading, peering at the bones, and scribbling in their notebooks.

Out at La Brea, the tar still bubbles, and the construction gangs go on working. Perhaps they can bring back the wilderness. We may hope at least that the museum will use its knowledge of display to show the public the origins of the fossils as tastefully as it shows the reconstructed skeletons. We may hope that Dr. Stock's effort to transplant trees and shrubs such as grew there in the Ice Age will serve to hide the comfort stations. We may wish Mr. Kanakoff luck when he starts digging again. The workmen have built him a house to dig under; when he's through digging, the new excavation is to be preserved there as a permanent exhibit. A test boring has told him there are some bones to be found in the spot selected. Let's hope he will have a rich harvest.



▲ BONING UP ON BONES: one of the many twentieth-century students who frequent Hancock Hall to take notes

HOW A *Rattlesnake Strikes*

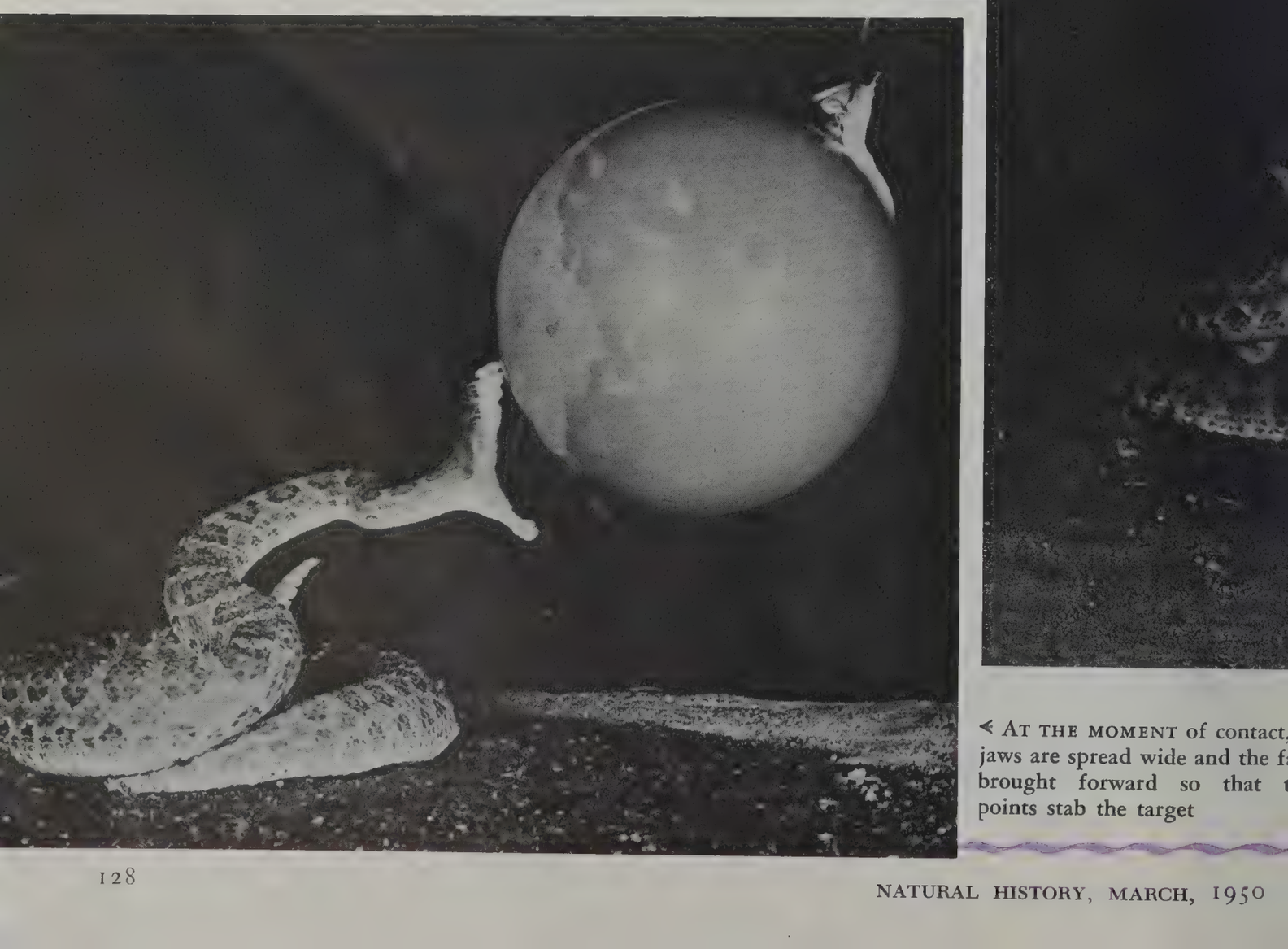
The superspeed camera shows how the snake spears its victim with its venomous fangs

By WALKER VAN RIPER
Denver Museum of Natural History
Photographs by the author

THAT the strike of the rattlesnake culminates in a stab rather than a bite is shown in the accompanying pictures. The venom-injecting apparatus of this reptile consists of two long and hollow teeth, the fangs, which are provided with holes near the point for discharge of the venom and are connected in the rear with venom glands and muscles that force the venom outward. The fangs are, in fact, the exact counterparts of hypodermic needles.

At rest, the fangs lie back against the upper jaw, almost parallel to the floor of the mouth, and are covered with a white membranous sheath. When the mouth is opened wide for a strike, the upper jawbone is rotated through nearly a 90-degree angle. The fangs are, at the same time, raised so that they point forward at the moment of impact. Only the points show, because the rest of the fangs are covered by the white cone-shaped sheaths. The photographs show how extremely wide the jaws are opened and that they remain wide open until the withdrawal movement is well under way. The snake shown is the Prairie Rattlesnake, *Crotalus viridis viridis*.

These pictures of the strike were taken with the high-speed electric flash invented by Dr. Harold E. Edgerton of M.I.T. Exposures are on the order of 1/10,000 of a second. Small rubber target balloons were employed in such a way as to trigger the flash at three different points during the strike. To get the flash at the exact moment of impact, the surface of the balloon was made conductive by dipping it in a warm salt solution, and the wire on which the balloon hung was



< AT THE MOMENT of contact, jaws are spread wide and the f brought forward so that t points stab the target

THE TONGUE projecting from the mouth of the Prairie Rattler in this exhibit is a sensory organ, not part of the venom-injecting apparatus

connected to one side of the trigger switch controlling the flash. The snake was placed on a pad of damp earth over a square of hardware cloth which was connected to the other side of the switch. Thus the first bare contact between the striking fangs and the balloon fired the flash.

To show the position of jaws and fangs at the moment the balloon burst, the switch points were fastened close together on the surface of the balloon in such a way that they would come into contact when the balloon collapsed. To get the action an instant later, with the withdrawal movement under way and the mouth closing, the switch points were handled in the same way but placed a little farther apart.

The withdrawal picture, which shows the return movement half completed while small pieces of the balloon are still in the air, gives some indication of the speed of the strike. It is incredibly fast. The first picture of the snake shows the long, black, forked tongue flicking out. This is often thought to be some sort of stinger, though in fact it is a highly useful sensory organ. What happens to the tongue when the snake strikes can be seen in the head-on picture, which shows the jaws wide open after the balloon has burst. The tongue is withdrawn into a protective sheath in the floor of the mouth. The black hole at the lower end of the lower jaw is the opening of this sheath.

HEAD-ON VIEW at instant of collapse of balloon. Note small black hole near front of lower jaw, into which the tongue has disappeared

WITHDRAWAL after striking the target

How Dangerous a

Hair-raising stories are written about the ferociousness of the tiger, the lion, and the bear, but the most dangerous animal of all may be lurking in your own cellar

By George G. Goodwin

Associate Curator, Department of Mammals, American Museum of Natural History

MOST animals of any size are dangerous to man, but fortunately for him they do not know it. Man has the advantage over the beasts of the field only in that he has armed himself with artificial weapons and protection. With few exceptions, animals are not aggressive toward man; the danger lies in their attempt to protect themselves from man.

As a protective measure a comparatively few species exercise collective armed might. The peccary is credited with combining forces to attack an aggressor, and a band of musk oxen will join together in a circle to protect all sides of their group from the onslaught of wolves, bears, or dogs. Honeybees and many of the social wasps will frequently attack in mass when someone threatens the safety of their nest. A stampeding herd of large animals is dangerous to anyone caught in its path, but the animals are fleeing from danger, not attacking.

Most animals and birds will fight to protect their young. The large carnivorous animals such as the big cats and bears are especially dangerous when they have cubs or kittens. Hawks will stoop at anyone climbing up to their eyries, and a goshawk will plough right in and severely claw anyone who gets too close to its young.

Drawings by Museum Illustrators Corps

MAN-EATING LIONS represent but a small percentage of the lion population. Most lions will run at the sight of man

Animals?

All through the ages, man has been afraid of the dark and the unknown. Everyone has heard the legends of vampires—batlike creatures that are supposed to suck your blood under cover of darkness. These legends are of Old World origin, which is strange in light of the fact that the only bats that actually subsist on blood are restricted to tropical America. The true vampires lacerate the arteries of human beings while they sleep and lap up the flow of blood, but they are comparatively small bats, and the loss of blood is not serious.

Animals have entered many fields of protective and aggressive warfare. The most effective and useful weapon is usually found in the mouth. Many insects have horny cutters encasing the mouth and can inflict terrific punishment for their size. Most mammals will fight their way to freedom with their teeth. But some, such as the rabbits, will not bite no matter how badly they are treated; and a few, such as the anteaters, do not have teeth.

The cats have the most highly specialized teeth for attacking, but the dogs have the strongest jaws. Tusks, such as those of the elephant, walrus, wild boar, etc., are used primarily for obtaining food, but they make effective weapons none the less. Teeth are practically useless without a strong jaw to drive them in and the power to hold. The snakes are an exception; their needle-sharp teeth are directed backward in the mouth so that the victim is virtually hooked – the harder he tries to escape, the deeper the teeth penetrate. The poisonous snakes inject their venomous fluid through their long hollow fangs, and a struggling victim only increases the dose of venom. This death-dealing serum is only injurious when it enters the blood stream. The snake can eat its victim without ill effect.

Tarantulas, black widow spiders, and the like have poison sacs in the mouth and are able to inject their venom into a wound. Scorpions, bees, and wasps inject their poison by means of a fine horny stinger situated at the hind end of the body.

The mammals have entered the field of chemical warfare. Most animals of the weasel family have anal glands specialized for ejecting a disagreeable and irritating fluid. The skunks have carried this specialization to the extreme. They can eject their obnoxious fluid in the form of a fine spray and can hit a target eight or nine feet away with remarkable accuracy. The charge is usually directed at the face of the aggressor and is most effective when it comes in contact with the eyes, nose, and mouth. The bite of some shrews has a mild toxic effect but is harmless to anything larger than a mouse.

Nails, in the form of claws and hoofs, are effective weapons. Cats have especially sharp claws, which, when not in use, are retracted and kept in a sheath to guard their fine points. Most hoofed animals will fight with their sharp forefeet. Horses kick and are very adept at whirling around and dealing a broadside with both heels simultaneously. When cornered, a kangaroo can defend itself from a whole

pack of hounds by means of a great claw on its hind foot. It will rip to ribbons any individual within its grasp.

Deer, oxen, sheep, and goats do not have upper teeth in the front of the mouth and cannot bite, but they have horns or antlers—in the male if not in both sexes. Horses, asses, and zebras, on the other hand, which have teeth in the front of both upper and lower jaws and therefore can and do bite, do not have horns or antlers. There is no doubt that in a head-on charge the antlers of the moose or elk present a more formidable front than the horns of a bison, but the antlers are only serviceable for about four months of the year, and only the male has them, except among reindeer or caribou. Horns, as distinct from antlers, are permanent appendages and are usually possessed by both sexes.

Dogs fight only with their teeth, but cats use claws as well. A bear goes one step further and crushes its victim with its arms. A grizzly can break the neck of an ox with one blow of its mighty paw. A big boa constrictor or python will strangle its victim by wrapping its body around it and contracting the coils. One of the large boas can crush a pig or small deer to pulp and swallow it whole.

Most of the people who have accidents with animals are careless or inexperienced hunters. A few persons get badly mauled by wounded animals, but most of the deaths occur when a hunter mistakes another person for an animal.

With the reduction of working hours and more time for leisure, there is a marked tendency for the average American to go farther afield for his recreation. Extended vacation periods and swift transportation bring the quiet and peace of many great wildlife reservations within the reach of almost every citizen, and even central Africa is less than two days away from New York by plane.

It is only natural that during these times of insecurity and unrest man should be instinctively drawn back to the cradle that raised him. Gone are the great herds of game from most of the world. Waving corn now sweeps over plains and prairies where once roamed the antelope and bison. An air of lonely silence hangs over the lofty mountain crags, the deep green woods, the still blue lakes. Occasionally a bear ambles out of the forest gloom, and the deer browse in remote woodland glades. These remnants of America's once great wildlife are forever on the alert, not so much for a natural foe but because they fear the presence of man. Even the scent of human beings borne on the breezes will send these creatures scurrying to safety. Most wild animals, great and small, have acquired a sincere respect for man. Even the grizzly bear, once America's most formidable creature of the wild, has learned to shun the hunter with his firearms. There was a time when all stepped aside for the grizzly; none disputed his lordly right. Today we are virtually safe from attack by *all* wild creatures, providing they are not provoked and we use reasonable discretion. Normally all the mighty beasts of the field flee at sight of man. In fact, unspoiled wild animals are much safer and more trustworthy than the domesticated creatures.

I do not know of a single authentic case in which a pack of American wolves has actually attacked a human being, and it is not improbable that most, if not all, of the tales of ferocious Russian wolves were based to a large extent on folklore and hearsay. Yet only recently, a pack of well-trained and cared-for bull terriers murderously attacked and killed a child for no apparent reason except perhaps out of sheer lust to kill. Everyone is familiar with the treacherous nature of the domestic bull. Many a farmer has been gored to death by a prize bull. Unprovoked attack cannot be charged in the same way against the wild bison.

It is true that every once in a while someone does get hurt by a wild animal. As might be expected, the public rises in wrathful indignation, demanding the creature's death. A life for a life may be poetic justice, but it is not fair to condemn a whole race because of the misdeed of one individual that has dared to attack man, the most ruthless of all killers. It was indeed a horrible tragedy when a black bear killed a three-year-old child in Michigan not long ago. Such a disaster naturally stirs deep

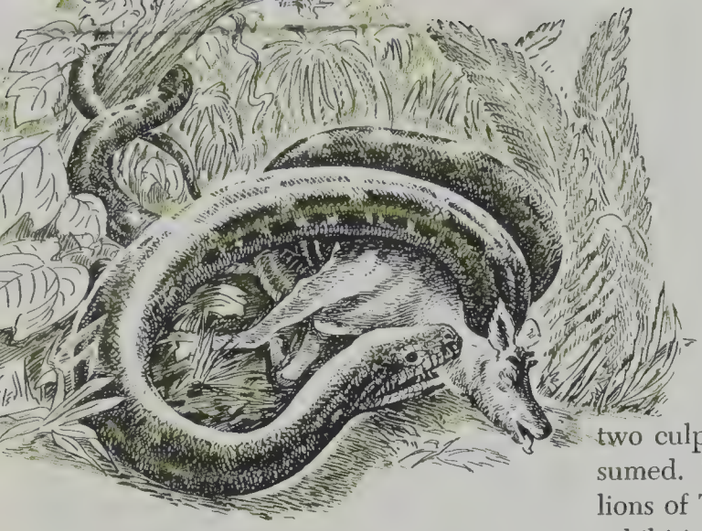
◂ RATTLESNAKES are one of our most dreaded creatures. Horses as well as deer kill them on sight

public feeling. Seemingly, there was no one to take the blame except the bear, and the chances are that the bear was not a really bad bear. At least, there was not sufficient evidence to accuse it of willful, premeditated murder. No criticism could be directed at the child's mother; she was used to seeing black bears around the house and to chasing the animals away with nothing more formidable than a broom. She was justified in her assumption that an untamed black bear would not attack without provocation. The animal is not a habitual meat eater but subsists principally on berries, nuts, roots, insects, and mice. Actual details of what happened, if they were available, might offer some explanation of this strange behavior. The child may have been eating candy and, as children are apt to do, smeared a liberal coating of sugar on her hands and face. The bear, being exceedingly partial to sweetmeats, may have carried the child off primarily for the sugar. Explanation will not bring back the child or soften the anguish of the parents. But somewhere along the line, human intervention had grievously erred in dealing with this particular bear.

▲ MOST ANIMALS AND BIRDS, like the osprey shown here, will fight to protect their young, but man is the aggressor

Where man's respect for the mighty beast of the field has waned, trouble must follow sooner or later. Wild creatures may temporarily be subjugated to the human will, and they may seem unresentful or even grateful for a hand-out of choice food, but under such circumstances they cannot be trusted unconditionally. As soon as their desires are frustrated and their respect for man has been dispelled, anything can happen. It is not only the bear that will turn and attack the hand that feeds it. A buck, hand-raised from a fawn and bottle-fed, may be a most exemplary pet during its tender years, but on reaching maturity it may suddenly and without provocation or warning turn on its master and attack. It should be remembered that when cornered or suddenly confronted with danger, and especially when wounded, any wild animal is apt to charge. This is not a treacherous attempt to kill but an act of self-preservation. A rhinoceros will almost always charge when surprised at close quarters, but given a reasonable warning it will put as much distance as it can between itself and the intruder. African buffaloes and elephants are among the most dangerous animals to hunt, not because of any resentment they may bear toward man but because when wounded or cornered they have courage enough to charge in an attempt to save their own lives. Rogue elephants and elephants "in must" are an exception, although even here it is a mental disorder or expulsion from the herd that makes them dangerous. On the other hand, the elephant is one of the few wild animals that can be trusted when domesticated. In fact, as Mr. W. A. Bevan, a wild animal collector, aptly puts it, "Elephants are grand people." Madge Bellamy tells of an incident where the quick thinking of a trained elephant averted a tragedy. It seems that in her act an elephant was supposed to make the pretense of kneeling on Miss Bellamy. On one occasion the posture was prolonged a fraction too long for the muscles of the poor beast. Being unable to support itself longer, it began to sink lower, thus increasing the pressure on Miss Bellamy. Apparently realizing that it was hurting her and would soon crush her, the elephant wrapped its trunk around Miss Bellamy and pulled her to safety, at the same time dropping on its knees with a crash.

Man-eating tigers and lions are usually elderly individuals that



A PYTHON takes a strangle hold on a deer, crushing it by contracting the coils of its body and anchoring its tail on a nearby tree

have lost most of their teeth and are no longer competent to catch wild game for themselves. But this is not always the case. With the exception of full-grown elephants, rhinoceroses, and hippopotamuses, there is no creature in Africa safe from attack by lions, man included. Accusations of man-eating, however, can only be levied against the individual and not against the species as a whole. Man-eaters represent but a small percentage of the lion population. Most lions will run at the sight of man. Lions undoubtedly have a great respect for man, and near human settlements they know full well that human flesh is taboo. Despite the fact that man is the easiest prey of all and can put up little resistance, lions never initiate the attack except under cover of darkness—the darker the night the greater the danger. In daylight there is practically no danger. The first offense is usually attributed to some unusual circumstance, but once having killed and having acquired the taste for human flesh, a lion will become a habitual man-eater. The reaction of the lion is parallel to that of the gambler who wins the first time and figures he has found a way to pick up easy money. A man-eater never devours its prey on the spot as it does other game but drags the victim away to the seclusion of the bush, as though aware that carelessness will defeat him in the end. The most notable man-eating lions were the two that actually held up the construction of the Uganda Railway in East Africa by repeatedly carrying off and devouring workmen. Eventually the engineer in charge, Mr. Patterson, killed the two culprits, and the work was resumed. These famous man-eating lions of Tsava are now mounted on exhibition at the Chicago Natural History Museum.

In southern Asia, tigers take a greater toll of human life than the lions in Africa, which is understandable since conditions are more favorable for them. In Asia, the native population is far denser than in Africa, and the jungles and tall grass close to the native villages provide cover for the tigers in their approach and retreat. As with the man-eating lions, it is only the occasional tiger that habitually preys on human beings. Reports of man-eating leopards are few and unsubstantiated, but a wounded leopard is an exceedingly dangerous animal.

Probably one of the best examples of what happens when uncontrolled animals have lost their respect for man is the wild dogs of the Ramapo Mountains, New Jersey. These dogs were descendants of domestic animals that had been left to forage for themselves. While they had sense enough to avoid closely populated communities and parties out to hunt them down, they would murderously attack an unarmed individual and sometimes treed a man for several days.

Then there are instances where visitors to zoological parks have disregarded signs and paid for their folly by the loss of an arm. The actions of caged animals are unpredictable, and anything thrust between the bars is acceptable as an offering of food.

For a while the bears in our national parks were encouraged to feed at hotel garbage dumps. This proved an interesting attraction for the tourists, but it was not long before the bears became uncontrollable. They ripped cars open in search of food and approached individual tourists to confiscate their lunch and candy. Fortunately, the park commissioners realized the potential danger and put a stop to unauthorized feeding of the animals.

It would be easy, of course, to call the malicious attacks of wild beasts on man a mystery of nature, but it is the business of natural scientists to find the immediate cause. In most, if not all, of the cases, the explanation is found in the definition of the word "wild." Wild, in the sense used for wild animals, means living in a state of nature unaided and without care of man. When animals are fed and cared for by man, they can no longer be classed as wild.

It is not always the inexperienced citizen that gets hurt by savage beasts. Experienced animal trainers and zoological park attendants are often badly mauled and occasionally killed by the animals in their care. The animal trainer who enters a cage of lions, tigers, or bears and makes them perform must be endowed with unfaltering determination and courage. He must not only keep his will dominant but must be able to predetermine the action of each animal. An indication of hesitation or fear would be fatal to the trainer. Only recently in California Miss Grace O. Wiley, an expert in handling venomous snakes, paid with her life for miscalculating the actions of a captive Sumatra cobra. Some unforeseen circumstance caused the snake to strike and sink its fangs into Miss Wiley's finger. She died 90 minutes later.

Poisonous snakes take a large toll of life in warm and tropical countries, but only a large python or boa constrictor would kill a man for food. Alligators and crocodiles are responsible for a few human casualties.

There are instances where fish have become habitual killers as a direct result of man's intervention in their scheme of things. In the West Indies, where the refuse from slaughterhouses is dumped into the ocean, barracudas congregate to feed and have acquired a lust for red meat. So ferocious have these creatures become that it is

not safe to bathe on any of the neighboring beaches. On more than one occasion, bathers have been viciously attacked by barracudas and literally torn to pieces by their rows of long spiked teeth before rescuers could reach them.

If you put your foot into one of the giant clams found in certain tropical waters, it will snap shut and hold like a vise, and you may be drowned before help arrives. Divers sometimes encounter octopuses, but the big and dangerous ones are usually in deep water.

On the other hand, dolphins apparently have been instrumental in saving the life of drowning persons by edging them onto the beach.

A summary of the principal cases in which so-called wild animals have attacked human beings shows that in most instances the animals have been spoiled by human kindness. Spoiled animals, like spoiled children, will take advantage of liberties extended to them.

Lions and tigers are among the most dangerous animals, and the African buffalo is in some ways even more formidable to hunt. But in answer to the question, "What is the most dangerous animal?" we must look elsewhere. There is a smaller creature that has taken a greater toll of human life than all the other forms of wildlife taken together. It is the rat. Even today, rats exact an enormous tribute each year, and everyone pays dearly for their support. In the war against rats, man has fought a losing battle; the hordes of pestilence carriers are on the increase. In well-governed lands, science has curbed the spread of disease by isolation and innoculation, but once a plague leaks out, the rats are there ready to carry it from city to city and from town to village. Most wild creatures serve some useful purpose, but this can hardly be said of the house rat, unless you argue that overpopulation is a menace to the human race. Unrestricted as an agent for spreading diseases, rats can and have in the past reduced the world's population faster than any other agent, including war. Hitler, with all his machines for destroying life, never approached the awful havoc meted out by rats.

Man is a born hunter, and if he goes looking for them, he will meet the large and dangerous animals. Although hunting is considered a social achievement in some classes, it is one of man's most primitive characteristics. There are those who shrink at the very thought of taking the life of any creature but, cut off from the supply of prepared food, even the timid soul will revert to the primitive instinct and hunt for food.

From the very beginning there has been a struggle between man's kindly nature and his desire to kill. When a child comes in close contact with a potential victim, a kindred feeling for the creature is quickly established, and he will endeavor to protect rather than harm it. Normal children are apt to try to restore life to a victim that they themselves have killed. Given a weapon, be it a stone, stick, or gun, the hunting instinct in a boy quickly dominates his kindly nature, and his sensitive feelings may not be hurt by seeing the victim suffer. With a gun in his hand he has a feeling of power; his ego is bolstered, and he can display his skill.

In developing the ability to reason, man shouldered the responsibility of curtailing suffering. Physical pain is a forerunner of death and is felt by all creatures. It is the first and most vital asset in the preservation of life. When you understand this, you will understand much in the behavior of animals, and you may be less inclined to provoke a wild animal to action.

▲ THERE ARE no authentic records of packs of American wolves attacking man. They do take their toll of the caribou in the far North

This unique photographic telescope is being used in one of the greatest projects in modern astronomy — compilation of the first atlas of the heavens

By
ROBERT R. COLES
Associate Curator, Hayden Planetarium, American Museum of Natural History

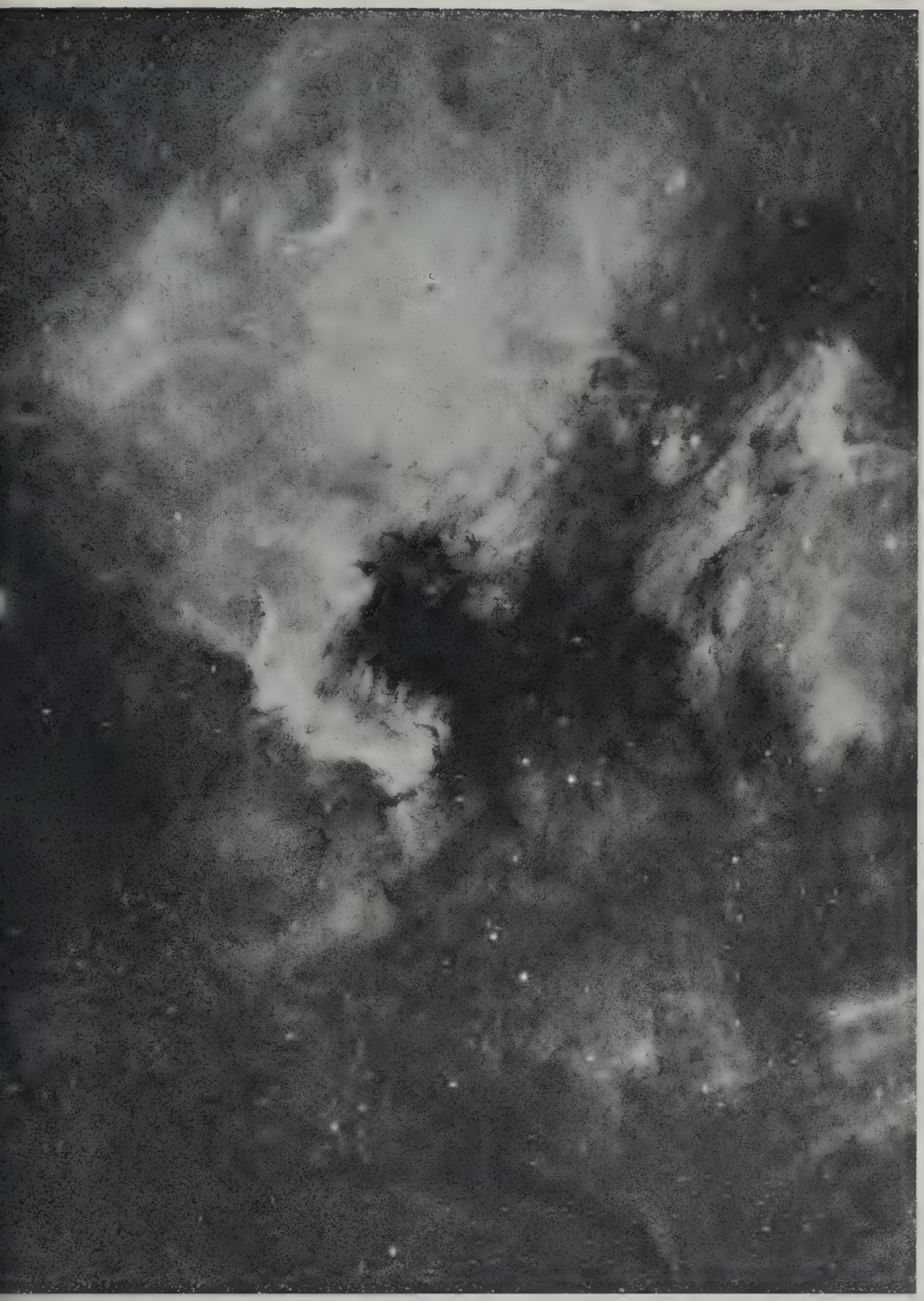
"Big Schmidt"

Little Giant of Palomar

ALL day Tuesday, July 19, 1949, astronomers on Palomar Mountain watched the heavens with more than casual interest. They were hoping for a clear night with good seeing. Fortunately, their hopes were fulfilled. It turned out to be one of those tranquil summer evenings that delight the hearts of the star doctors. The deepening sky became a canopy of velvet in which the brighter stars sparkled like gems. As the final afterglow of twilight faded into the full dark of night, the entire heavens blossomed like a beautiful celestial garden.

It was in this perfect setting that one of the greatest projects in modern astronomy was launched—the National Geographic-Palomar Observatory Sky Survey. The work began with the taking of two photographs of a particularly interesting region of the heavens in the constellation of Cygnus, the Swan. The center of interest in these pictures was the famous North America Nebula, a mass of stars and gaseous interstellar matter that bears a striking resemblance to the continent of North America.

➤ DR. EDWIN P. HUBBLE, dean of American astronomers, directing the final rehearsal of the 48-inch Schmidt for its exhaustive survey of the sky. Teammate of the 200-inch Hale, this unique telescope has already begun to reveal new and startling facts about our solar system



▲ THE FIRST PHOTOGRAPH taken by the Schmidt of the famous North America Nebula, so-named because it bears a striking resemblance to the continent of North America. The Schmidt phototelescope will in four years complete a survey that would take the 200-inch telescope 5000 years

The object of this program is the compilation of a new star atlas that will include the heavens visible from Palomar Mountain. From that latitude, three-fourths of the heavens surrounding the earth can be photographed with accuracy. About ten per cent more, a so-called "fringe area," can be covered in some degree but not as sharply as the rest. A supplementary survey will be necessary to obtain this fringe area with the desired accuracy, and the remaining fifteen per cent that is out of reach far down in the southern hemisphere. It will involve the making of several thousand photographs on plates measuring 14 by 14 inches, each covering an area of the sky about 7 degrees square. When completed, there will be 20 large volumes, and the atlas will be made available to observatories at cost. It is estimated that the price of each atlas will be about $2,000.

Surprising as it may seem, this work is not being done with the much-heralded 200-inch giant eye of Palomar but with a smaller instrument known as the Schmidt telescope. There are two of these on Palomar Mountain, used in conjunction with the larger reflector. One, called the 18-inch Schmidt, has been in successful operation for several years. Its companion, the 48-inch Schmidt, which was completed last year, is now being employed in the present survey.

To the casual visitor this telescope resembles a huge cannon more than anything else. It looks like something out of an H. G. Wells novel. In reality, it is one of the greatest marvels of modern precision engineering. Its basic design is quite like that of any other reflecting telescope, with a large mirror to capture the light messages from the stars. But there are several small but important differences. These include a different shape for the big mirror—spherical in the Schmidt telescope instead of parabolic. The addition of a specially-designed correcting lens at the center of curvature of the large mirror plus other modifications make it very much better suited for photographic survey work than any other type of telescope, including the 200-inch reflector. The latter, despite its ability to penetrate a billion light-years of space, can photograph only a very limited area without distortion. The Schmidt phototelescope will complete this job in about four years. The "Big Eye" would take 5000 years.

Because of its unique design, the 48-inch Schmidt will photograph a much larger area with almost perfect definition to the edge of the plate. And while the large Schmidt telescope cannot reach as far into space as the 200-inch reflector, it still has a penetrating power of 300 million light-years!

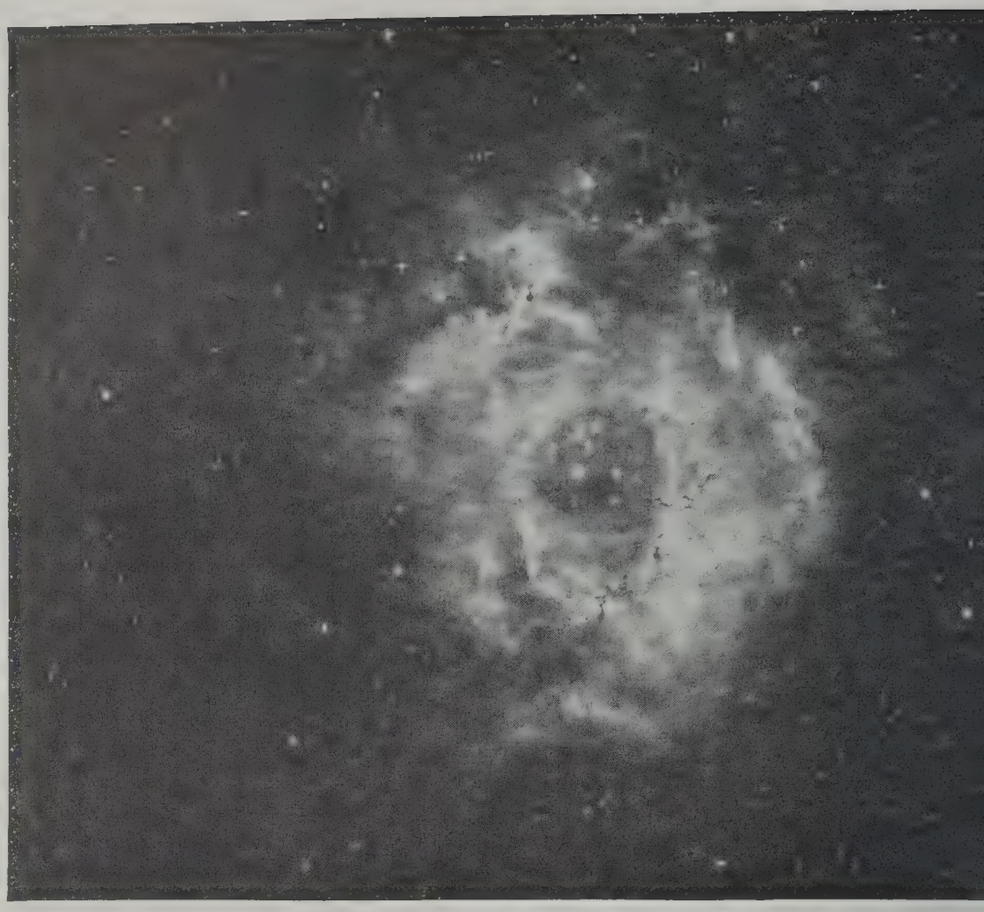
Another surprising fact about the Schmidt instrument is that it cannot be used for direct visual observation. This is because of the way it is built. It is impossible for the observer to get his eye in position to observe the image reflected by the large mirror. In

place of the eye, a photographic plate is held in that position to receive and record the image. Being exclusively a photographic device, it is often referred to as the "Schmidt Camera." It is equipped with two 10-inch refracting telescopes for guiding. These are mounted on opposite sides of the barrel so that one is always accessible from the floor, where the astronomer works.

The Schmidt camera was invented about 20 years ago by Bernard Schmidt, an associate at the Hamburg Observatory in Germany. But this unadorned statement ignores the most fascinating part of the story, which focuses on the unique personality of the man whose dreams and endeavors came to fruition with the completion of this remarkable instrument. The story really begins some 70 years ago, with the creation of a lens from the round bottom of a broken bottle by a lad in an Estonian Island village. Young Bernard Schmidt was the eccentric son of a German father and a Swiss mother. Even then, young Bernard was different from other children. Friends and neighbors thought him queer because of his shy manner and the insatiable curiosity that, indeed, on one occasion almost cost him his young life. At ten, Bernard became interested in explosives and one day set out to build a bomb that would produce a tremendous noise. After packing a quantity of powder into an iron pipe, he attached an improvised detonator. Just as his experiment seemed to be progressing successfully, there was a terrible explosion. The bomb went off too soon—and young Bernard lost one of his arms.

Had it not been for this accident, astronomers of today might be without the Schmidt camera, for the budding scientist directed his attention away from explosives and into the less dangerous avenue of optics.

His utter lack of equipment and funds did not deter him in the least. It was only a year or so later that he fashioned the crude lens from the bottle glass by grinding it in a saucer of sand. Later, upon hearing of the new process called photography, he built a simple camera out of an old cigar box and began to experiment with the film then available. In these two projects can be recognized the root of the great instruments that today bear his name.



↑ ENLARGEMENT of a small section of a test-run photo made by the "Big Schmid showing a portion of the Milky Way in the constellation of Monoceros. T nebula is actually a cloud of dust and gas illuminated by near-by stars

From those early formative years, Schmidt's major interest was optics, and when ready for higher education he sought expert instruction in Sweden and later at a technical school near Jena, the famous optical center in Germany. After that he began experiments on his own and ground his first professional telescope mirrors. It was a hand-to-mouth existence, but he eventually became associated with the Hamburg Observatory. It is reported that he was a most unusual man—an individualist of the first order. Among other eccentricities was his habit of working in a claw-hammer cutaway coat and striped trousers. Little interested in money, he rejected several remunerative positions in favor of work more in line with his special interests. His colleagues recall how they often saw him pacing absentmindedly about the streets of Bergdorf, a suburb of Hamburg, with his hat pulled down and his cigar tilted up so that it seemed his hat brim might be ignited at any moment.

This shy, retiring genius, who coveted independence above all else, was the man to whom the astronomers turned in the 1920's for the solution to one of their most technical and perplexing problems.

At that time it was impossible to take telescopic photographs that were clear and sharp over the entire negative. Several theories for solving this problem were submitted to Schmidt, but none of them seemed to him practical. In 1926, he announced his ideas for a solution, but they were not favorably received. He said no more but refused to be defeated. Three years later he was crossing the Indian Ocean, en route to the Philippines on a German eclipse expedition. With him was Dr. Walter Baade, of

the Hamburg Observatory. In the course of a conversation, Schmidt mentioned that he had worked out the solution for the "perfect mirror." He proceeded to explain the principle upon which it should be designed.

Dr. Baade enthusiastically suggested that Schmidt should build one on his return. But it was not until the summer of 1930 that he completed his first test instrument, a 14-inch model. One Sunday afternoon he invited Dr. Baade to witness a demonstration of his revolutionary phototelescope. From an attic window, he trained it on a cemetery some distance away. Dr. Baade peered into the eyepiece.

"Can you read the names on the tombstones?" Schmidt asked.

"Yes," came Baade's elated reply. "But I can really see only one thing —the optics are absolutely marvelous!"

Astronomers were skeptical of the possibilities, however, and real progress was not made until Dr. Baade presented the idea to the astronomers at Mt. Wilson, California, in 1931. Bernard Schmidt died in 1935 without knowing whether his dream would ever be translated from blueprints to reality.

Already the 48-inch Schmidt has proved it superiority in the field of survey work. It made astronomical history last summer when it captured the image of a previously unknown asteroid, or minor planet, which moves nearer the sun than any other known body except a comet. At times this object, which is probably less than a mile in diameter, approaches to within 22 million miles of the sun. Further study of its behavior may shed light on the evolution of the solar system and will perhaps aid astronomers in more accurately determining the mass of Mercury.

In this survey two exposures are being made in every region of the sky covered. One of these is on film sensitive to red light, the other on film sensitive to blue. In many instances the two exposures reveal very different pictures. This is because some stars radiate a predominance of red light while others show more of the blue. Another advantage of the red-sensitive film is that it is more efficient than the blue in penetrating the haze that is so pronounced in some regions of interstellar space. This is particularly dense in the region of the Milky Way.

While it is impossible to list all of the benefits of such a survey at the present time, a number of them are quite obvious. Estimates indicate that the survey will record a total of some 5000 million stars and perhaps 10 million stellar systems beyond our galaxy. It will serve primarily as a patrol camera for the larger 200-inch telescope. In addition, the atlas will be a useful research guide for many other observatories in the United States and abroad. It will undoubtedly add to our knowledge of the architecture and dimensions of our own galaxy and provide a more complete census of the various types of objects it contains. It should also yield valuable information on the distribution and density of matter in interstellar space and perhaps offer a clue to the origin of the stars. In the past, these nebulous clouds have proved very annoying to the astronomer by hiding much of the cosmos. The use of red-sensitive film will carry our sight farther into these mysterious depths of space. At the same time, the survey will reveal important facts about the distribution of thousands of galaxies of stars (the so-called island universes) beyond the outposts of our own stellar system. Thus it should provide a better understanding of the over-all structure of the cosmos. Last summer's discovery of the new asteroid shows that the camera is already on its way to revealing new and startling facts about our own "little" corner of space—the solar system.

The possibilities that lie ahead in this great undertaking are truly startling. It will certainly reveal scores of celestial marvels as yet unknown to the most learned astronomers. Quite possibly the discoveries of the 48-inch Schmidt during the next four years will overshadow anything that may come from the more publicized 200-inch Hale reflector. Certainly it will more than justify its name – the Little Giant of Palomar.

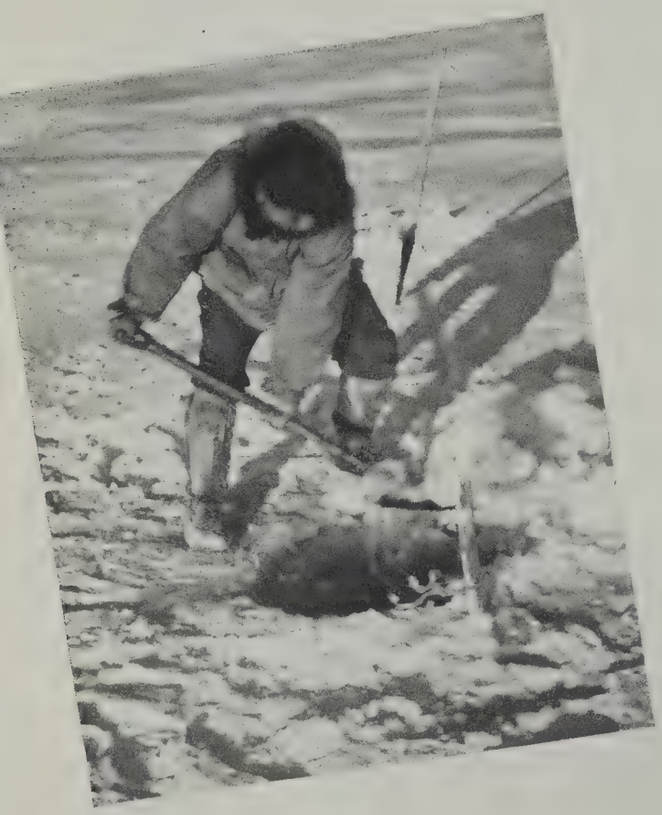
SKY SURVEY EXPERTS: Dr. Albert G. Wilson (*left*), key astronomer in the project, checks over some test negatives, while Dr. Walter Baade, close associate of the inventor of the "Big Schmidt," looks on

▲ SEVERAL HOLES about fifteen feet apart are hopped in the ice. Then a line is threaded beneath ne ice by means of a long pole, and a net is rawn through and fastened at the two end holes

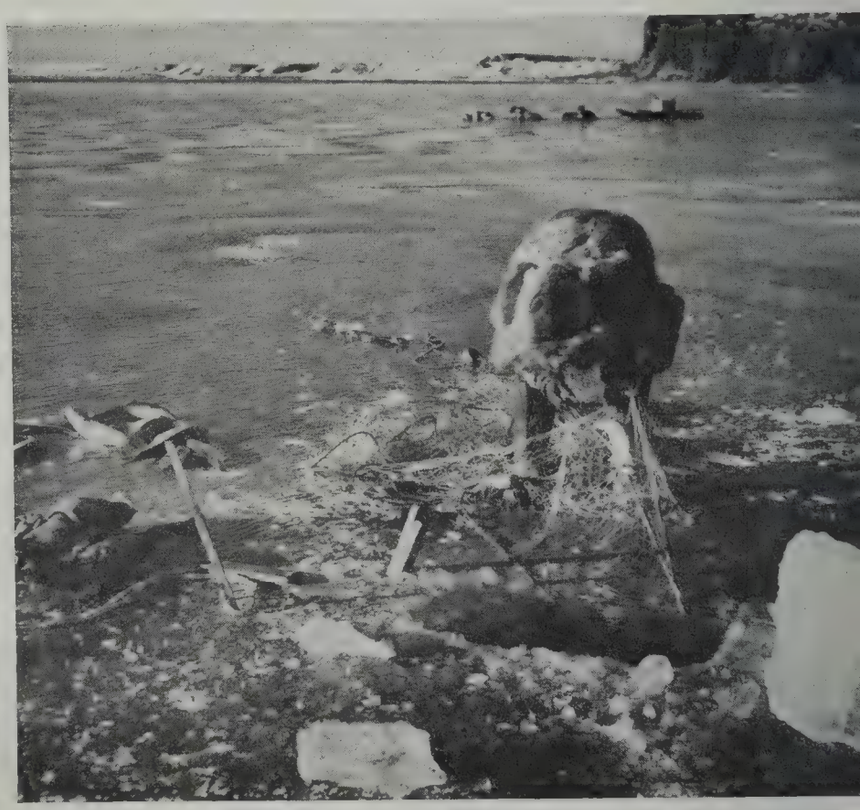
Fishing under the ice

An unbroken expanse of ice does not prevent the wily Eskimo from harvesting the bounty of the sea

By THE REV. CANON J. H. WEBSTER
St. Andrew's Mission, Coppermine, N. W. T.
Photographs by the author



▲ AFTER the net is set, only the two end holes are kept open. The others are allowed to freeze over. This boy is removing ice that has been broken by the long-handled chisel in the background



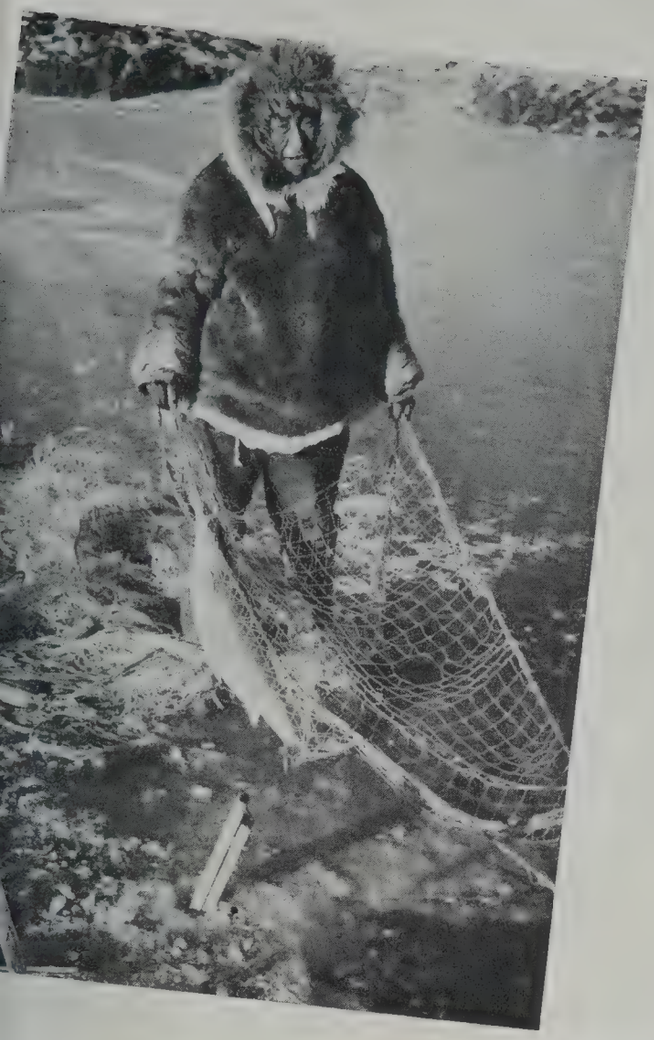
▲ TO REMOVE the fish, the net is loosened at one end and pulled out through the other hole, with the line still attached for rethreading. Note the dogs waiting in the background

MISSION: MALARIA

Continued from page 111

the same cage with a different partner, it showed little concern. However, if we put one in a different cage, either with the same or with a new mate, it dashed about wildly before settling down. Apparently remaining in the same cage was of more importance to the animals than remaining with same partner.

Naturally we had hoped that our caged pairs would eventually present us with elephant shrewlets, but we hoped in vain and saw no signs of mating. Later we learned that a South African embryologist had been attempting to raise these animals in captivity for 20 years without success. Babies born shortly after capture were destroyed by their mothers, but some brought in along with the females were nursed and carefully attended. One or two young are born at a time. They are quite like the adults except for scattered long black hairs in the coat.



◄ CHILLY WORK with bare hands, but well worth it. In some parts of the Arctic, seals are caught similarly in nets set around the breathing hole to which the seal must come periodically for air

▼ ICEBOX: a storage bin made of slabs of ice sealed together with slushy snow, which will keep the fish safe from prowling animals

Fear among elephant shrews is expressed by low screams, excitement and warning by a rapid and surprisingly loud rapping with one hind foot. Four shrews, two males and two females, bit us consistently when we handled them, but none of the other hundred did.

We found no fleas or lice in their fur but many small ticks. Tapeworms and nematodes were common in their digestive tracts.

At the same time that we were domesticating our animals we were studying hundreds of samples of their blood. The malaria looked surprisingly like human malaria but lacked those important asexual stages that keep the infection alive in the blood without further innoculation by the insect. Periodic examination of the blood, often at six-hour intervals day and night, failed to disclose these stages.

We were still perplexed over this strange phenomenon when the time came to fly the animals back to Dr. Huff at the Naval Medical Research Institute. Another worrisome time came then, for I was sent to Nairobi for an operation, and Chief Lawless was left alone with our "patients." The next day the rest of the naval party returned to Juba and helped Lawless prepare the elephant shrews for shipment in light metal cages that we had ordered from Nairobi. Commander Ruebush was assigned to head the party back, and he and Lawless recaged the first lot of elephant shrews ever to be sent to the United States. A few days later, when the big Navy plane had taken them across the Atlantic and settled down at the Washington National Airport, the animals were, I am told, more fit than their keepers. All of the 104 elephant shrews that we had started taming a month earlier arrived safely.

Even after extensive work on the parasite of the elephant shrew, Dr. Huff now finds some of the main problems unsolved. His original demand for a laboratory mammal with a type of malaria similar to man's has not been satisfied by the elephant shrew. Aside from the difficulties of keeping the animal alive and the apparent impossibility of raising a colony in the laboratory, no way is as yet known for transferring the infection experimentally from shrew to shrew.

But the disease does suggest a host of problems that it is important to solve at this stage of malaria research. We made another short trip to the southern Sudan during 1948 to investigate further elephant shrew malaria and other blood diseases of the wild animals there; but that is an unfinished story. As this is published, we are in the midst of a three-year tour of African duty for the Navy, and our first assignment is to try to fill in the many gaps in our knowledge of elephant shrew malaria.

BOOKS

Continued from page 103

inherent in such power, partly, he suggests, because civilization as a whole was still firmly rooted in a Christian ethic that could govern the use to which it might be put. But also, it seems, because the potential then available was still far from carrying the destructive force which modern science can place in ruthless hands. When one of the great physicists declares that no knowledge is better than modern science in the service of the irresponsible, we have reached a stage that is nothing less than critical.

Dr. von Weizsäcker in his *The History of Nature* has faced this transcendent problem of our time by writing a book on the essence of nature including man. He bridges the gaps created by our extreme specialization and lays before the reader a masterly summation of the historic course of nature, spanning the origin and structure of the universe on the one hand and the nature of man and his soul on the other.

The emergence of human consciousness and of a soul become in Dr. von Weizsäcker's history the culmination of a long series of events which alone can make their uniqueness understandable. It is only in the soul that hope for the future can be found. Knowledge with love is mankind's salvation.

This is a deeply moving book based on a broad erudition, simple in outline, profound in its insights.

HARRY L. SHAPIRO

AMERICAN HEARTWOOD

---- By Donald Culross Peattie

Houghton Mifflin, $3.50
307 pp., 19 woodcuts

A NEW book by Donald Culross Peattie will be hailed by all American naturalists. The present volume, however, is a series of 19 episodes from the "heart" of American history, written against the background of its exploited woods. The 19 chapters (whose subjects are well veiled in their literary titles) take one from Erik the Red through the boom and bust of the Comstock Lode. Each isolated narrative is told with authoritative detail, with the color and atmosphere of its times, in a style that is as graceful as it is fluent and with an imagination that adds immeasurably to its vividness. It is Peattie the historian who speaks more than Peattie the naturalist. Although many tales start and end at his California garden home with reflections worthy of John Burroughs, in others the naturalist may be obscured.

Peattie the historian—or perhaps, the patriot—assumes a new stature in this volume. He believes firmly, devoutly, almost simply, in the inherent greatness and goodness of America. Superlatives abound, directed always toward our democracy, our freedom, our abundance, our way of life. Of the rest of the world, he says little or nothing. If he must mention a few stains in our history, it is only to glorify our deeds of erasing them. As an historian, he looks backward, not at the present or forward. The problems of our economists today and the deep concerns of such conservationists as Osborn and Vogt are incompatible with his sense of American perfection. Nor is he a lover of the primitive wilderness, either for sentiment or for science. The disappearance of the passenger pigeon and the bison go not only unlamented but even as praiseworthy because way is made for farms and fences, wheat and clover, of his greater America.

FRANK E. EGLER

LETTERS

Continued from page 98

ground was literally covered with tiny baby frogs. He dismounted and, upon examination, found them very active, uniform, and about the size of a large horsefly. The wagon ruts in the old logging road he was traveling were filled with them. It was really impossible to avoid tramping on them.

Where could these frogs have come from? Buzzle and Trowl creeks were fed by the winter's snow and by springs and therefore went dry in the summer. Marble Creek was over the rise of the hills and mountains. The St. Joe River was at least sixteen miles away.

The baby frogs came with the rain, but from where? Is there some simple explanation for this apparently baffling occurrence?

MRS. RENA COLLINS FAIRFIELD
Spokane, Wash.

The following comments are offered by Mr. C. M. Bogert of the American Museum's Department of Amphibians and Reptiles:

In referring to "frogs," Mrs. Fairfield is using the correct name for all tailless amphibians, but the creatures her husband saw were undoubtedly toads in the popular sense of the word. Few frogs wander far from water, whereas the toads, once they have graduated from the tadpole stage, are principally land dwellers.

The appearance of hordes of small toads following a rain is not uncommon in arid portions of the United States. In Idaho those seen may have been either the Rocky Mountain Toad (*Bufo w. woodhousii*) or the Northwestern Toad (*B. b. boreas*). Farther south in the deserts one occasionally sees similar swarms of the Colorado River Toad (*B. alvarius*) or the Desert Toad (*B. punctatus*).

The explanation is relatively simple. Toads deposit their eggs in pools, usually in the spring, but in arid regions deposition must await the rainy season as well as suitably high temperatures. Seepages or springs, some of them temporary, provide sufficient water to permit toads to carry out their breeding activities. Pools in almost any situation are utilized. Even relatively tiny pockets along rocky cliffs often contain the characteristically black tadpoles, which emerge from the egg within two or three days after deposition.

The tadpoles are dependent upon plants such as the green algae or "pond scum" as well as upon small animals that appear in the pools soon after they are formed. The tadpoles of some toads are able to dispense with their gills within a month and a half, meanwhile having acquired legs as well as lungs that leave them free to emerge and hop about on the land. They are ordinarily most active at night, and the young may spread out in all directions from the isolated breeding points. To avoid the dry surface, they first seek shelter near the natal pool in rodent burrows, under rocks, or in any sort of crevice where some moisture is retained. Migration from the breeding site, where the available insect food of the transformed young can scarcely support many toads, is restricted until the advent of additional rain. Thereupon, the young toads come out from their moist places of concealment and continue their journeys, sometimes all of them in one area heading in the same direction. In most instances we can do little more than guess concerning the stimulus that directs the migration, however.

Doubtless many young toads are killed before the rain subsides and once more forces them to locate suitable shelter. A more or less permanent abode is finally established from which the toad emerges to feed whenever there is sufficient humidity in the air at ground level. No actual pool is necessary because the toad is able to absorb water from the moist earth that surrounds it in its chosen sanctum. The desert toad, an inhabitant of dry canyons, possesses a flattened body that presumably enables it to find suitable crevices with greater ease. In the Grand Canyon, for example, rains bring it forth in great numbers. Otherwise it is rarely encountered, although I once looked beneath an oak keg placed under a trickle from the rocks in Bright Angel Creek and found over two dozen toads solidly packed beneath the moist wooden bottom.

Dubious as it seems from superficial appearances, moisture is present not far below the surface in many desert regions. Ordinarily, to be sure, there is not enough

Photo by Gladys Diesing

▲ CYPRESS AND THE SEA. Flattened and twisted by the continual buffeting of the wind from the sea, the Monterey Cypress (*Cupressus macrocarpa*) grows in its natural state only in a limited area a few hundred feet from the ocean. This picture was taken on the Seventeen-Mile Drive which makes a circle of the Monterey Peninsula from Monterey to Carmel, California

to flow into an excavation. Nonetheless, in the large dunes not far south of El Paso in Chihuahua, I once followed the example of the local coyotes, whose excavations I could see, and found that murky but quite palatable water was available scarcely more than a foot below the surface. Sufficient moisture was present on the surface in the depressions between the dunes to satisfy the needs of a toad, with its absorbent skin.

Thus toads manage to survive in portions of the desert where the mean annual rainfall is no more than three inches. Indeed, on the only occasion when I crossed the extremely arid section between Gila Bend and the Colorado River during a night rain, several toads were seen along the highway. Where they had found enough water to breed I could only guess, but it was a fair assumption that if I had searched the region at the right time, I might well have found the young migrating from one of the few breeding sites that must exist in the region. How far they travel no one knows, but at times it must be a matter of miles.

The sudden appearance of swarms of toads following thundershowers has given rise to the myth, widely believed in many parts of the world, that it "rains toads." Indeed, a violent updraft accompanying a thunderstorm might occasionally carry a few small toads upward and drop them at a distance. So the myth may have this much foundation to strengthen it, but ordinarily the great numbers of toads that appear after rainfall in arid regions have come from their places of seclusion in the ground—not from the sky!

Kiwis from Way Back

SIRS:

I was very much interested in reading in the February issue of NATURAL HISTORY the article concerning the Kiwi. It might interest you to know that this name was used for the ground forces in the U. S. Army Flying Service during the First World War. My brother was in Army Aviation some time in 1917 until the middle of 1919. During his period of service, I heard him use this phrase to designate aviation ground troops on more than one occasion. He said that this was quite common in the service, although the soldiers did not seem to know whether the bird was from Australia or New Zealand. They knew very little about it, except that it could not fly.

ALFRED W. GALE

Troy, N. Y.

▲ AN "USHER" at the opening of spring: the wood frog (*Rana sylvatica sylvatica*) wears a distinguishing black mask about the eye

Belted Kingfisher

SIRS:

At your convenience, I would appreciate your comments on the following:

On Dec. 12, 1949, I saw a Belted Kingfisher feeding while on wing from the water in a creek near my home. There was broken ice in the water, as the temperature had reached three degrees above zero two days previous.

Reference books I've checked say this species winters in southern United States. Inasmuch as I've never heard of these birds being seen hereabout at this season of the year, I'm curious to know if this is an unusual occurrence.

WILLIAM A. BREEN

Troy, N. Y.

The following comments are offered by Mr. C. K. Nichols of the American Museum's Bird Department:

Although the Belted Kingfisher is recognized as a migrant bird in the northeastern part of the United States, it is true that some individuals will remain throughout the winter if there is open water with food in the vicinity.

In southern New York and in northern New Jersey, a few may be found every winter unless the weather has been very severe and the streams completely icebound. It must be a rare occurrence for a kingfisher to winter in the vicinity of Troy, for it is probable that its opportunity to find food in that latitude is rather slight. But this has been an unusually mild winter, and the feeding conditions in your vicinity have not been too difficult.

Do Crickets Damage Clothes?

SIRS:

Your article on the clothes moth was most valuable and has saved much time and energy. . . . I would now like to ask whether there is anything in a belief here in the Rio Grande Valley that our crickets eat wool. People chastise me for allowing them to remain in my house.

GLADYS H. OSBORNE, M.D.

Harlingen, Tex.

The following answer to this question is offered by Dr. C. H. Curran of the American Museum's Department of Insects and Spiders:

In normal outdoor conditions, crickets are vegetarians, but when they enter warm buildings, they are liable to change their habits, and they may then damage woolens, cottons, and silks. The damage usually results from the presence of foreign substances on these materials. Grease spots or stains will attract them. Clothes subject to perspiration and put away without cleaning attract them because of the salt present. The starch in clothing, both old and new, furnishes food. It is while eating these added substances that cloth is damaged.

Many people consider the presence of crickets in the house a good omen. A singing cricket is supposed to bring good luck to the household. Others believe that the singing of crickets in the house portends the early approach of winter, a natural assumption where American crickets are concerned, because they enter buildings to escape the cold. The house cricket, a native of Europe but now occurring in parts of the United States, is the creature made famous by Dickens's *The Cricket on the Hearth.* In this country the late Frank E. Lutz studied the sound-making apparatus and recorded the sounds of this cricket (see NATURAL HISTORY, December, 1938), and the cheerful chirps of these creatures could usually be heard in his home.

The Chinese and Japanese highly prize the "songs" of their native crickets, and keep the insects in cages, some of them quite expensive, in the same way that we keep prized canaries. Male crickets are naturally pugnacious, and the Chinese have also developed a fighting race. From $50.00 to $100.00 (old currency) was about the average price paid for a good fighter. Fights between good fighters would attract thousands of dollars in bets. A cricket of Canton, known as "Ghengis Khan," is said to have won fights with as much as $90,000 (U. S.) at stake. When kept as pets, crickets will eat a variety of leafy vegetables. Lettuce is a favorite food.

Epic to be Proud of

SIRS:

Let me express appreciation of Louis R. Huber's splendid tribute to certain of our fellow Alaskans in his article, "The Incredible Conquest of Mt. McKinley." From its all-inclusive title to its final Anglo-Saxon "grit," no more words are needed. The excellent reproductions of Mr. Washburn's well-chosen photographs round out the story of an epic of which we of the North can well be proud.

FRANK H. WASKEY

Fortuna Ledge, Alaska

SIRS:

May I just take a moment to compliment you on the recent issues of NATURAL HISTORY Magazine. I notice my children seem far more interested in it than they have been in the past few years, and I know that I am finding a tremendous amount of enjoyment in simply looking through it. I also find that I sit down to read an article through rather than just to thumb through the pages as I used to do.

You certainly are doing an excellent job. Congratulations!

IRVINE H. MILLGATE,
Director of Visual Education

Boy Scouts of America
New York, N. Y.

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pril NATURAL HISTORY 195

Golden Anniversary 1900-1950

Fifty Years

By F. Trubee Davison

President, American Museum of Natural History

NATURAL HISTORY Magazine had its origin in April of 1900 with the publication of a small, 16-page leaflet, *The American Museum Journal.*

In those early days, with something less than 1000 members on its rolls, the Museum felt the need for a periodical that would provide information on Museum activities and exhibits to scientists and members.

What is known throughout the

Progress

world today as NATURAL HISTORY Magazine was at that time envisioned as an aid to a small group of scientists and laymen. The initial publication, under the careful editorship of Dr. William K. Gregory, who is now known internationally as one of the world's foremost authorities on comparative anatomy, was successful in acquainting this audience with the activities of a relatively young institution.

The first half of our twentieth century might well be termed the era of scientific awakening. Probably no other period in history has been marked by such outstanding scientific achievements. The very term "science" has only come into broad usage during this half century when a bewildered public sought to keep pace with the almost unbelievable accomplishments of the scientists.

Hundreds of magazines have come into being during this time, each competing for the public eye. Honest reporting has had to compete with propaganda journalism. The survival of serious, informative, and truly inspiring periodicals has been threatened by sensational ones. The progress we have enjoyed has been made possible by the encouragement and support of those who believe in these objectives.

Publishing activity has been by no means less feverish in the scientific field than in any other. Amid the spectacular interest that is daily captured by the technological sciences, progress with a magazine devoted to the enduring truths of nature has not been easy. There is a far greater volume of material published each month on the physical and mechanical sciences, but we are gratified to learn that few magazines are saved from the wastebasket and cherished so long by their subscribers as NATURAL HISTORY.

The story of NATURAL HISTORY is, I believe, unique in publishing annals. The problems confronting every commercial publication have sometimes seemed minor when compared with those NATURAL HISTORY has endured for half a century. In commercial publishing, every resource at the command of the publisher is directed toward the magazine, its production, its editorial make-up, and its promotion and circulation. NATURAL HISTORY is not published by a commercial concern. It is published by a great American scientific and educational institution as but one phase of an extensive and world-wide program which exerts a tremendous educational influence on millions of people every year.

In view of the scope of the Museum's activities, plus the limitations of staff and budget expenditures in all departments, it can readily be appreciated that the Museum has been unable to give NATURAL HISTORY Magazine the financial support it certainly deserves. The severe limitations under which NATURAL HISTORY has had to work for the past 50 years would have long since relegated to oblivion most commercial publications. Indeed, many periodicals favored with abundant operating capital have gone under during this period.

During the early years of its existence, the editorial content of NATURAL HISTORY was directed solely to those of a scholarly, scientific mind. A circulation saturation point was soon reached in this limited audience. Consequently, NATURAL HISTORY broadened its coverage so that its editorial content would be found understandable, entertaining, and educational to a much larger group. An almost insurmountable problem, however, was to make the American public aware that such a magazine was available. This was a job of promotion and selling.

As every person engaged in business knows, to promote and sell a commodity successfully entails considerable financial expenditure, and this the Museum was unable to underwrite. Those in charge undertook to accomplish a job that was readily labeled "impossible" by professional circulation experts. Since we could not raise ourselves in any other way, we had to do it by our own bootstraps.

The circulation growth of NATURAL HISTORY has not been meteoric, but its success does astound the commercial world when it is understood how little was spent to achieve our present circulation of more than 40,000 paid readers. It is significant too that the Magazine has not resorted to exotic interpretation of the natural sciences in order to garner widespread attention. The editorial advisers have felt that anything verging on the overdramatic would render NATURAL HISTORY ineffective in the dissemination of facts in the natural sciences.

During its existence, NATURAL HISTORY has published more than 15,000,000 words and over 27,000 illustrations. It has given its readers the personal accounts of the most celebrated explorers of our time, and it has set no limits on its geographical or historical range. It has stirred many an American home both with the wonders of far-flung places and with the sometimes more startling mysteries and marvels of nature close to home. All this has been accomplished through the unflagging industry of a small editorial force and of an office of circulation and promotion that has been seriously handicapped by shortage in personnel and facilities.

The officers of the Magazine feel that there are hundreds of thousands of people in this country and abroad who would welcome learning about NATURAL HISTORY and who would be willing to subscribe to it. Here is a family magazine that inspires wholesome thinking and embodies a philosophy of simple, intelligent living. We enter our second half-century with gratitude for the encouragement and support that all our readers have given us and with fervent hope for the future of a periodical that exemplifies and moves forward in a sphere of human thought and experience that is constantly increasing in importance.

Keystone

Gendreau

The Gifts of Nature

By HERBERT HOOVER

I was a boy in the days before our civilization became so perfectly covered with cement and bricks. As a boy in the villages of Iowa and Oregon, aside from chores, it was my business to discover the world all over again. There were the wonders of the woods and the streams with their animals, their birds, and their fishes. There was the miracle of the growing crops, the excitement of the harvest and of the home-made Christmas. There was the comfort of the family fireside in a civilization where every season produced the bread, the meat, the vegetables, and the fruit which gave social security over the winter.

Afterward my engineering profession took me to many foreign lands, where I dealt with the people of many nations and nationalities. My boyhood interest in the birds and the beasts and the fishes continued.

And it has been my privilege to work with great spiritual leaders and great statesmen. I have worked in governments of free men and in governments without freedom. I have seen happiness; I have witnessed destruction, great troubles, and sadness: the battlefields of two frightful wars, the suffering of famine and pestilence. I have seen people devoted to their governments, and I have seen people rebel against their tyrannies. I have seen them cling to recreation at the woods, the streams, and the sea as an escape.

Those countries where the people were devoted to their government were those in which the individual was free to choose for himself and to develop his own talents and enterprises. But the opportunity to develop was limited by the natural resources, and these came from Nature itself—not from governments. This development of nature's offerings was not alone their bounty but was the product of freedom and the ingenuity of races. We descendants of Western Europe are mechanically-minded and take to making and running machines, while the peoples of Asia and Africa, with different backgrounds, imitate and fumble with them.

But amid all these machines, bricks, and cement, there is the primeval joy of all races of getting back to nature—for recreation and to wash one's soul of the complexities of our modern life.

One of the products of the mechanical age is to give us more spare time. What we do with this leisure has to do with the spiritual life of both the individual and the nation. As a nation, Americans have done much to bring recreation nearer to nature itself. Between 1928 and 1932, our National Parks and Monuments increased 40 per cent—and we have improved the hunting and fishing. Hunters and fishermen are not those who fill our jails.

Many of these opportunities of the out-of-doors were destroyed by the march of cultivation of the land and the use of our resources for personal comforts. But we still have great opportunities, for no one can destroy the magnificent monuments of nature. And these bountiful gifts with which our land is endowed are part of our sacred national trust.

From them, the contemplation of the flow of the stream, the cathedrals of the redwoods, the majesty of the mountains—all remind us of our humble role in the order of things. Many of us have to work at the bench and in the shop. We cannot go to these refreshments of the mind as much as we would like. But such institutions as the American Museum of Natural History make available to all of us and our children the wonders of nature—and remind us of the Gifts of Nature from which we derive so much of our strength.

NATURAL HISTORY

The Magazine of the American Museum of Natural History

F. Trubee Davison, President | Wayne M. Faunce, Vice-Director, In charge of Publications | Albert E. Parr, Director

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THE COVER THIS MONTH

Mitten Butte is a familiar landmark to many travelers who have chosen to put the well-traveled routes behind them and struck north from Kayenta, Arizona, into Monument Valley. Throughout our Southwest and even the world, the spires and mesas of Monument Valley stand as a classic example of the startling topography that can be carved by natural forces in an arid or semiarid climate. Warm hues of brown and yellow tint the buttes and shafts of rock that dot this elevated landscape and impart an unearthly beauty. Most visitors, however, particularly if they visit the region in a hot, dry spell, do not think of this portion of our land as being a riot of floral coloring. The cliff rose, technically known as *Cowania stansburiana* whose golden blossoms enliven the foreground of this photograph, is a leafy evergreen shrub that grows frequently on cliffs and belongs to the rose family. It grows to a height of from three to twelve feet and occasionally twice as much. It is often called quinine bush because its twigs and leaves are quite bitter, but this does not prevent cattle, deer, and sheep from feeding upon it. The Hopis prepare from the plant an emetic and a wash for wounds. —Ed.

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The American Museum is open to the public every day in the year without charge

The Next Half Centu

Eight scientists at the American Museum give a

Rapid Progress or Rapid Defeat

Through leisurely processes requiring millions and millions of years, animals became specialized for life on earth, in air, and in water. Man, a comparative newcomer, was earth-bound. Barehanded, he kept to his limited habitat until technical accomplishments provided a short cut across the eons. Today he has overrun the earth, he lives in the air, and only the ocean depths oppose him.

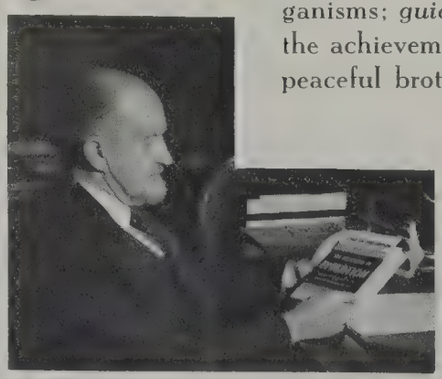
The greatest speed-up in this human expansion came in the past fifty years. The next fifty, with the Atomic Age luring him on, may well place man at the utmost capacity for life achieved by any creature and carry him far beyond anything common to our present experience. This, if his use of the shining tool is wise; the Atomic Age can well spell his doom.

Harold E. Anthony
Chairman, Department of Mammals

New Comprehension, Power, Guidance

Constructive study of evolution will oppose the powers of physical destruction and spiritual bondage. The synthesis of evolutionary science will increasingly involve all life sciences and extend farther into the psychological and social sciences. The goal is increased comprehension, power, and guidance: *comprehension* of how life has arisen and developed, of our place in the living world and the universe; *power,* through knowledge of the principles of organic change, to influence desirable development of man and other organisms; *guidance,* derived from true understanding of life, toward the achievement of sound ethical and social values as the basis for peaceful brotherhood of mankind.

G. G. Simpson
Chairman, Department of Geology and Paleontology



n Science

se of tomorrow

Fewer Atomic Worries—Graver Population Problems

This is not a prophecy. It is an article of faith combined with a piece of guesswork. First, I believe, in common with many others, that mankind has a future, because man can and will rise to the moral demands implicit in the possession of the self-destructive powers he now has learned to manipulate.

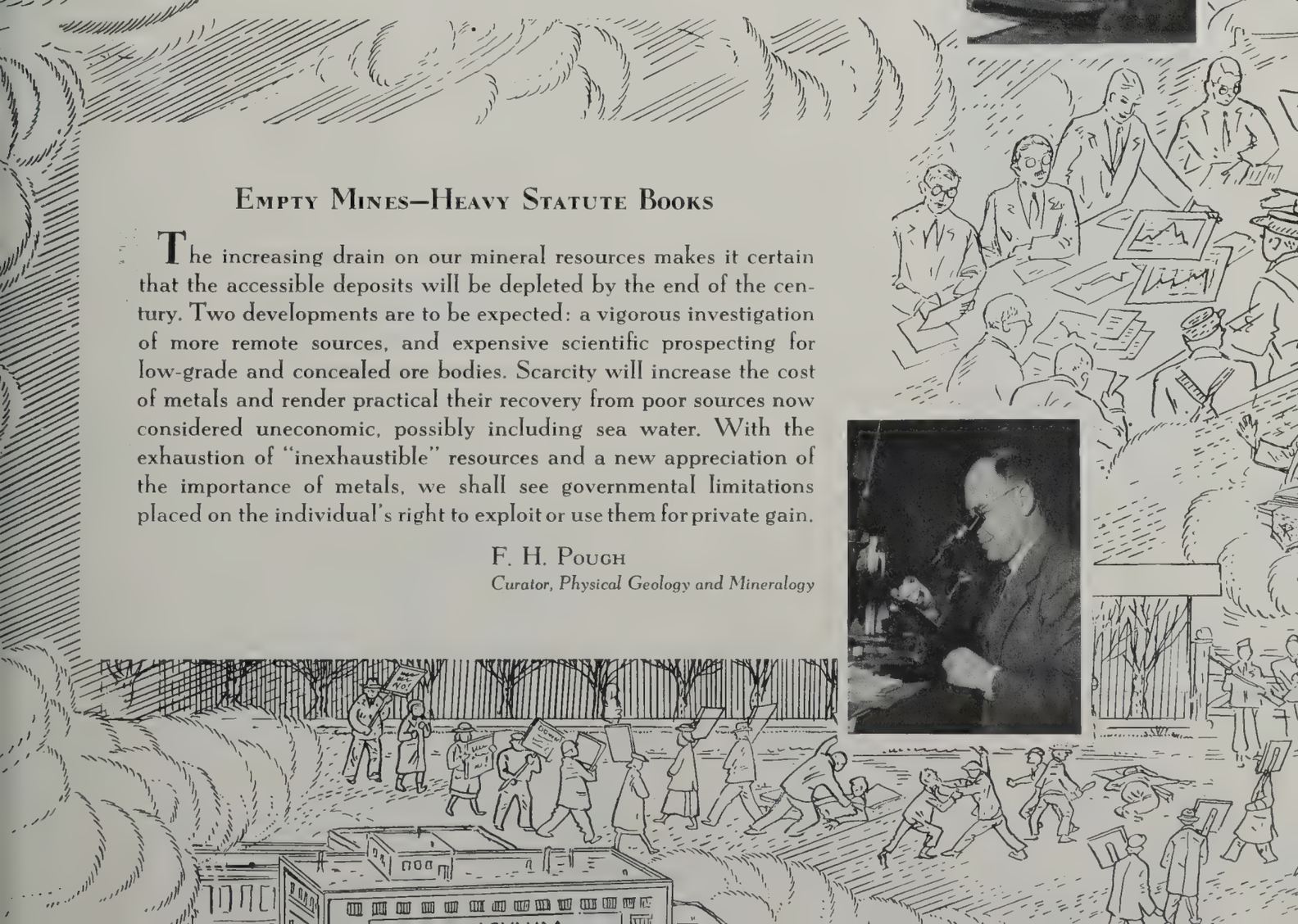
Admitting this probability, I judge from existing population dynamics and from advances in technology that the world's population will increase by at least fifty per cent in the next fifty years. The task we face is the tremendous one of understanding the economic, social, and political stresses that will result and of discovering a method of dealing with them.

Harry L. Shapiro
Chairman, Department of Anthropology

Empty Mines—Heavy Statute Books

The increasing drain on our mineral resources makes it certain that the accessible deposits will be depleted by the end of the century. Two developments are to be expected: a vigorous investigation of more remote sources, and expensive scientific prospecting for low-grade and concealed ore bodies. Scarcity will increase the cost of metals and render practical their recovery from poor sources now considered uneconomic, possibly including sea water. With the exhaustion of "inexhaustible" resources and a new appreciation of the importance of metals, we shall see governmental limitations placed on the individual's right to exploit or use them for private gain.

F. H. Pough
Curator, Physical Geology and Mineralogy



Dull Diet, Desperation, and a Population Plan

I believe that by A.D. 2000 mankind will have worked out the technical problems of food production far enough to permit the earth to support many more than the three billion then on it. Already we can produce enough yeast from an acre of sugar cane to supply the annual protein requirements of over 100 persons. However, I am convinced that wherever a country's entire population is being forced to eat little except such unpalatable foodstuffs as yeast "steak," algal "butter," and wood "sugar" in order to stay alive, we shall see vigorous steps taken to reduce the population to a level where the available land can support it on more appetizing foods.

Richard H. Pough
Curator, Conservation and Use of National Resources

Change and Growth Through Understanding

Our task is to bring into moving equilibrium our knowledge of the physical world and our special knowledge of human beings. This involves learning how to bring to the study of human beings our full humanity, how to include the observer within the observational situation. To do this we need to orchestrate studies of human behavior from many different civilizations, so their historically developed insights may each contribute some of the hypotheses essential to a scientific understanding of mankind. Such a method generously employed should lay the groundwork for a world civilization capable of change and growth in an increasingly understood universe.

Margaret Mead
Associate Curator of Ethnology

Brotherhood Through Science, Art, and Music

I predict that the growing need for international understanding will lead to the development in New York City of an entirely new type of institution for the presentation of cultural and scientific subjects. Enjoying the broadest foundations, this sister to the United Nations will embrace the arts, history, health, and science and will include the portrayal of opera, symphony, folk dances, and choral programming. Through it, audiences will be placed in the environment of each country around the world and be able to hear, see, and feel how other people live. I predict that such an institution will have a large share in promoting better understanding among the peoples of the world.

Gordon Atwater
Chairman, Astronomy and the Hayden Planetarium

A New Partnership Between Science and Education

The half century from 1850 to 1900 was characterized by an attempt to gain scientific understanding of the physiology and origin of man. Since 1900 there has been a scientific approach to the psychological processes of man. The next half century must see the scientist concerned with the extension of his science to include the improvement of man as a social being. Therefore, for the first time in history, the scientist and the educator must progress along the same road, side by side, in mutual recognition of the fact that science not only extends the world but is essential to its welfare.

Charles Russell
Chairman, Department of Education

Drawings by Paula Hutchison

It's for You to Choos

We think of 50 years as a long time. On Earth's great timepiece, it is a second. But there is a sundial that says: "It's later than you think."

Once, long before man, it was *size* that counted. A little animal only a foot long, which has been popularly called Leaping Lena, founded a dynasty of giant creatures that could reach leaves three stories above the ground.

If we could have watched the growth of the dinosaurs through 140 million years, we might have believed that size and strength alone were most desirable for success. But Nature had something else in store—something that was to wipe the giants from the earth, almost as if they had never lived.

It became common for a small animal to win over a large one. In a limited sense, the meek inherited the earth. Actually, a better nervous system was evolving. Evolution was laying the foundations for the creature that talks, laughs, plans, and calls himself master of the world—the creature that invents, chooses, and learns from books—the creature whose mysterious desires can bring him close to God and whose pride can cast him lower than the beast.

This creature shivered his way through half a million years before he discovered how to make fire. It took him almost as long again to make a good machine to put it out.

Evolution teaches that three things are necessary to produce change—Variation, Selection, Transmission. If all of Leaping Lena's children had been alike, there could have been no change. But anyone who has dogs knows that there are variations in every li the wild, some young are better able to survive th ards of life—are stronger, swifter, more gifted arts of concealment. So a process of natural se takes place. The ones better fitted to meet life's tions are more apt to survive to maturity. An that reach maturity are more likely to secure a ma duce their kind, and transmit their effective traits next generation.

There is a comparison between this kind of ev —organic evolution—and cultural evolution.

The difference is that cultural evolution refer the tools that man uses and all his laws and so stitutions. These are not passed on by hered chiefly through books and spoken tradition.

In cultural evolution, *invention* plays the part *ation. Choice* takes the place of *natural selectio* a lot of things that might be bunched together *"education"* take the place of *transmission* an alive the tools and customs we judge desirable form the design for tomorrow. The design is th tage we leave our children.

So we have Invention, Choice, Design.

Speech was the first great achievement that p on the road to cultural evolution. It permitted th mission of powers from parent to child without ity. Written language greatly quickened the p because it took the burden off memory.

Man now has a multitude of machines to he

Editorial Written on the 50th Anniversary of Natural History Magazine

new machines. He even has electronic "brains" e mathematical problems.

e last 50 years, science has given us the motion , the airplane, radio, poison gas, television, radar, pulsion, atomic power, antibiotics, and the tools erial warfare.

e next 50 years, science will give us things that long life and things that will shorten it; things ll appeal to your highest nature and to your low- t no one can tell what the world will be like, e it's for you to choose.

are beginning to see that our skill in choosing r behind our inventive talent. We find ourselves a 100-mile-an-hour car with a 10-mile-an-hour g wheel.

ether we shall spiral upward or downward will upon this process called Choice. As long as freedom of judgment, it is up to you to choose. sts will help us beyond their role of inventing sting new paths. They will advise. But the choice e yours.

ased on this vital act of choice are two powerful One is the creed that Might Makes Right. The s the belief that the Strong Shall Help the Weak. eeds on hate, the other on love. One is destruc- he other creative. One breeds strife, the other They are at opposite poles. You can't very well e in both at the same time.

nce will give us miracles. We shall need also the e that raises us above our creature origin. Science can plant two seeds where there was one. So can the thief grow more vicious, the larger the loot.

It tires man to fix his calendar to the seasons and his timepiece to the stirring of life in a tiny cell. The wheels can be spread on the laboratory table, but who can yet put them together? We plant the seed in the field and then must wait, obedient to natural law. Before God, can we show surprise if, after sowing atoms and confessing no regret, we are to reap them?

We are all one with the earth and shall return to it. The slum-child pressing its cheek to the fresh grass. A man going home to the mountain.

Invention—Choice—Design. For good or ill, these are the handmaidens of our destiny. When Choice becomes Moral Responsibility, Invention becomes Inspiration, and the Design is full of Hope.

It's for you to choose.

Two wars leave us in pain, and the world is sick. Black, white, yellow, red—each in his Maker's image; each exalted, each tempted. At home we deny our brother, while we add new strength to the old weapon. We were born in the day but have defiled our place in the sun. Those born in the night reach for our hand but do not find it; and a cloud rolls in, low over the earth.

Our brief time here has been a wedding of Hate and Power. In this union, dare we pray for the daughters of Love—Moral Responsibility, Inspiration, Hope?

Having brought ourselves to the edge of Eternity, dare we *not* pray for them?

Edward M. Weyer, Jr.
Editor

The Man Who Reads It

By JOHN KIERAN

FIFTY years ago in New York City there occurred two events, one of which was noteworthy. That was the founding of NATURAL HISTORY Magazine at the American Museum of Natural History. The other, of somewhat lesser importance to the world at large, was my first intrusion into the halls of the same museum. Possibly the editors were even then editing copy or correcting proofs of the first issue of this magazine as I wondered along under escort of my father. But though I wrote a fair round hand for a boy of seven, I was not invited to contribute anything to the periodical that was about to be launched so successfully. I have been a regular visitor to the museum ever since that comparatively ancient day, and a constant reader of this magazine for many years now. I think the museum and the magazine have taken notable steps forward in the past fifty years, and it's a good thing, too, because the need for such a museum and such a magazine has steadily increased over this period.

Consider the drift in our population. There was a time when most of the inhabitants of the United States lived on farms. They knew Nature because they had to wrestle with it to make a living. They knew crops. They knew trees. They knew birds and animals. Weather was important to them. They lifted their heads to the stars on clear nights. Moonlight had social significance in the farming districts. Who pauses to look at the moon over Manhattan? Nearly 80,000,000 of our population are now classified as "urban dwellers" or, to be frank about it, city folk. This is the era of mechanical marvels. We have the assembly line in the factory and the push-button technique in the office. We are surrounded with so many mechanical aids and manufactured gadgets that we often act like mechanical men. We forget we are human beings. In our admiration—verging on adoration—of the electrified, streamlined, jet-propelled modern world of skyscrapers, television, stratospheric flight, and atomic energy in which we live, we are losing sight of the far greater immortal miracles of Nature that are all around us—from the tiniest drop of water that can be put under a microscope to the great stars in their distant courses, some of which dwarf not only the Earth by comparison but "our whole dinged solar system," as Bert Leston Taylor put it in his famous lines about Canopus.

Matthew Arnold wrote of Sophocles that he "saw life steadily and saw it whole." All too many of us can't take that broad view these days. We are trapped within walls. We have too many miles to go before we can get off paved streets and plant our feet on solid ground. Life in a big city is becoming a rat

DEAR EDITOR:

It was with surprise and pleasure learned from your letter that my nam been picked at random from the thou of Museum members and NATURAL HI Magazine subscribers to tell why I reader of your splendid publication.

When, by chance, several years heard of NATURAL HISTORY, I immed subscribed because my son has always a typical outdoor boy, wandering i woods and being thrilled with his ob tions of wild animals and birds. I could pages of his bringing home all kinds o mals found locally, and once he even a young hawk.

NATURAL HISTORY proved to be his treasured magazine, for he has enjoy to the utmost and preserved every co

I always had only a normal, passiv terest in nature, but I find that now, an avid reader of NATURAL HISTORY, more conscious of the world of nature me, and I am amazed at how much k edge I have acquired and retained th the years about the peoples of this and the fascinating story of Mother E

My son is now with the U. S. M stationed in Guam, and when his mothe sister and I have finished with each of NATURAL HISTORY we send it to hi this is one of his most insistent request has written us many interesting stories wildlife there in the jungle. It is your

race. The modern age is so marvelous that for most of us it's like the Looking Glass land into which Alice ventured, where the pace was so fast that the Red Queen warned Alice, "It takes all the running you can do to keep in the same place." We rush so much that we lose track of time. We concentrate so much that we narrow our vision. There is a wonderful world around us to explore and enjoy. That's the reason for the existence of the American Museum of Natural History. That's the reason for the publication of NATURAL HISTORY Magazine and the justified jubilation on the occasion of its fiftieth birthday.

In the museum and in the pages of this magazine we can and do travel far by land, sea, and air. We visit Africa, Asia, Australia. We take trips to the arctic and antarctic, with all the thrills of the explorers and none of their hardships. We look into the interior of the Earth. We find rare metals. We learn the cause of earthquakes. We go down to the depths of the ocean and see astonishing forms of marine life. We visit the tropics and see strange flowers and birds of almost incredible plumage. We look through a telescope and see a pin point of light that may be a star ten times the size of our Sun. We learn why we have eclipses of the Sun and Moon. We discover that the most adventurous of men lead humdrum lives in comparison with the fantastic careers of many insects. We are finally convinced that the largest living creature ever seen on Earth was not some scaled and tailed prehistoric monster that we know only through ancient bones or fossilized footprints on the sands of Time but a warm-blooded, seagoing animal that still lives and breathes in this modern age—the great Blue Whale.

How much all this means to others I have no way of knowing with accuracy, but it has been a great part of my own life. As a boy, I was always fond of hunting and fishing and camping, but it wasn't until I was out of college that I became deeply enmeshed in the delights of amateur ornithology. From the attic window of our house in the Bronx I could look out over the waters of the Jerome Park Reservoir. One winter day I saw that there were many scattered ducks on the reservoir. I borrowed a pair of field glasses, sneaked along the iron fence that circled the reservoir, and looked over the ducks to identify them. Some I was unable to identify until I went back to the house and peered into my Chapman's *Handbook of Birds of Eastern North America.* I saw fourteen species of wildfowl on the reservoir, and the group included one white-winged scoter, some canvasbacks, a few redheads, and a hooded merganser.

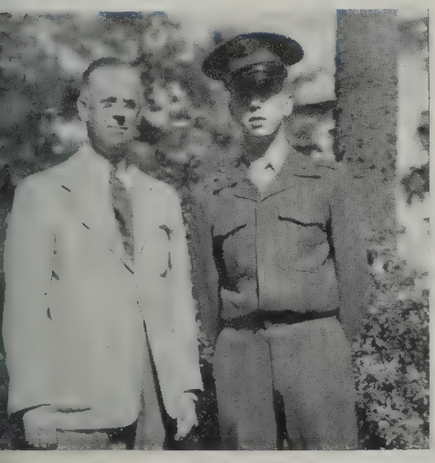
At the Bronx Zoo that winter I met a man who had a way of getting bird notes into a column in the N. Y. *Evening Mail,* a newspaper now long out of print. I induced him to go with me to the reservoir to see "my ducks," and in due time their presence on a reservoir in New York City was made known in a paragraph on the editorial page of the *Evening Mail.* That brought some visitors from the American Museum of Natural History to look over the duck situation in the Bronx. I encountered two of the museum men on my rounds and told them I was keeping a daily watch on the coming and going of the various species. They nodded approvingly. To this very day I feel a little proud of those nods of approval, because the two men from the museum were Charles Rogers and Ludlow Griscom!

Some months later, when Dr. Rogers saw how deeply enthusiastic I was about birds, he asked me to go with him to the meetings of the Linnaean Society of New York at the American Museum of Natural History, and he very kindly put me up for membership. Nobody arose to oppose the nomination, and I was duly elected. I have been a member of the Linnaean Society ever since.

I often felt like one of the conspirators in *Julius Caesar* as I hurried along 77th Street in the darkness, turned at the driveway leading to the brooding old building, slipped under the dark archway, and whispered the password "Linnaean" to the challenge of the uniformed attendant at the door. It was a thrill to attend those little gatherings of long ago, but it is a much greater thrill now to walk through the spacious halls of the new wings of the museum and see the marvelous habitat groups of birds and animals, the antelope groups that might delude a visitor into thinking that he was on the African veldt, and the Pacific bird groups that lure the bird lover "on from island unto island at the gateways of the day."

As the American Museum of Natural History has expanded nobly and improved immeasurably, NATURAL HISTORY Magazine has made remarkable progress in the presentation of important and fascinating subject matter. What is offered in NATURAL HISTORY is the truth that is stranger than fiction. There are stories of scientific journeys to the ends of the earth. They are written by men who know their subjects

Continued on page 191



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Yours sincerely,
D. J. BUCKLE

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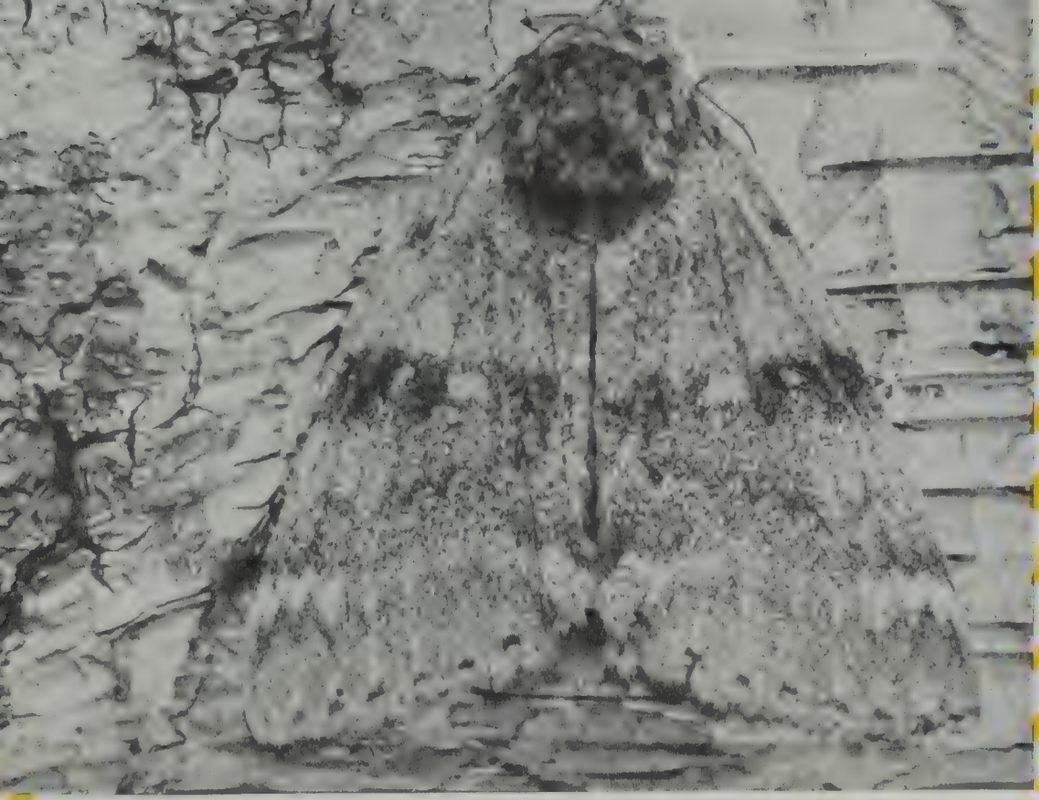


CAMO in N

▲ THE OUTLINE OF THE WINGS in this moth (*Catocala relicta* Walker) is lost against the bark of the tree

The art of concealment makes many a weak creature strong in the struggle against its natural enemies

By LORUS J. *and* MARGERY J. MILNE
University of New Hampshire

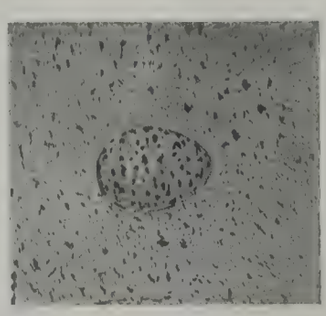
Photographs by the authors unless otherwise credited

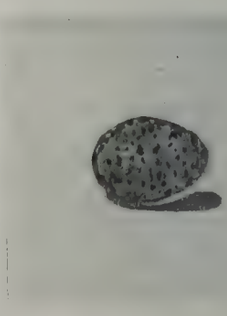
FROM the beginning of life on earth, all the varied creatures of the animal kingdom have had one objective in common—the need of finding a square meal. And since every creature is liable at one time or another to be looked upon as a possible source of food by some other animal, survival has depended upon various arts of concealment. We are all aware of the furtive tactics of a cat stalking a mouse and of the habit of the mouse to seek dark places and to enter openings too small for a larger animal. But nature has also endowed many animals with startling physical attributes that help them to escape notice—in short, with natural camouflage.

To be successful, camouflage requires that an animal blend so perfectly with its background or surroundings as to be indistinguishable from them. It is a means of concealment through absence of contrast. This lack of contrast may be in tone, in texture, or in color. Thus a killdeer's eggs on a bare sea beach, a rabbit crouching among roadside weeds, an underwing moth on a gray tree trunk, all challenge human vision. Usually each is passed unheeded—an unseen example of the protective resemblance so widespread in the animal kingdom. Each taxes the most observant eye and also the brain that interprets the eye's seeing. Each trick of camouflage has a definite survival value for the creature concerned.

Colors are so much a part of our everyday life that it is difficult to think of the world without them.

Against a confusing background of foliage, the spots of the giraffe look like patches of shadow and serve to hide the profile of an animal that is famous for its grotesque shape





A speckled egg is hard to see on a bare beach unless there is strong shadow: an example of protective resemblance

LAGE
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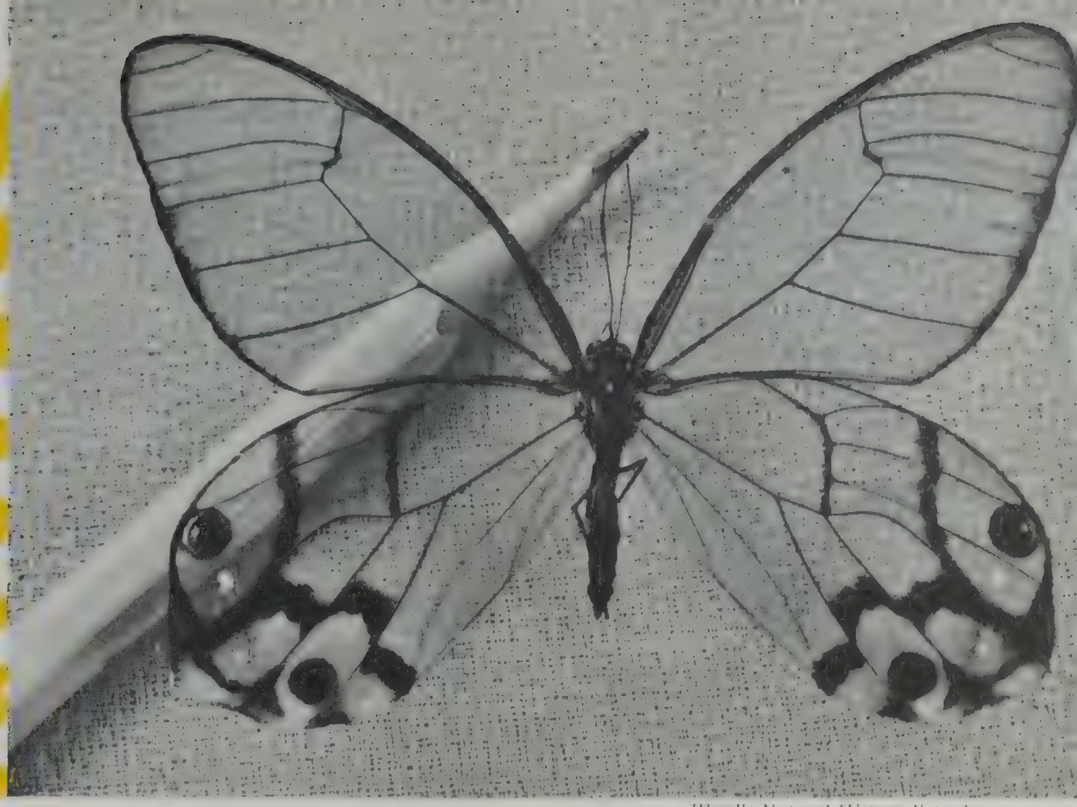


Ward's Natural History Est. photo

▲ THE GLASS-WING BUTTERFLY (*Haetera piera* L.) from the American tropics is so transparent that it is hard to see in flight

But as far as can be learned, we and the other primates (monkeys, apes, and their kin) are the only mammals that can distinguish the various regions of the spectrum except through differences in brightness. Birds, fishes, and insects may have good color vision, though different from ours. But among our familiar four-footed friends—the horse and cow, dog and cat, rabbit and guinea pig—we find no recognition of color. For them scenery, enemies, and mates exist only in shades of gray. How then do their eyes evaluate what we call camouflage? What is protective coloration to an animal that is truly color-blind?

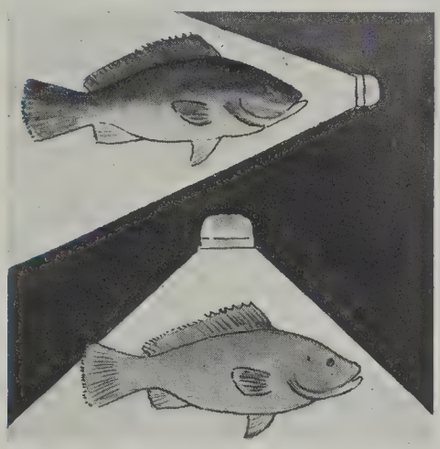
For us, the landscape and its inhabitants consist of a kaleidoscope of multicolored patches—some light, some dark, most in-between. We depend upon our mental analysis of this patchwork when inspecting objects beyond our reach. Outlines, we conclude, must mark off separate parts. Sudden changes in color or brightness are portions of the outline. Gradual transitions suggest continued planes, while roundness and shadow-casting go hand in hand. We base each judgment on combined appreciation of difference in color and variations in brightness. Yet where this color sense is lacking, the same scene need not mean monotony. Only photographers dream up the extreme examples and point out that a white cat sleeping on an ermine coat spread under a noonday snowstorm (a "high key" picture) may be just as devoid of details as a black cat eating licorice in an unlit coal cellar at midnight (a "low key" picture). Both situations are extremes rarely met with. Neither involves color. But a green katydid imperceptibly quivering its green wings to scrape out its familiar calls on a dark night is no more contrasty on a green leaf when illuminated by a floodlight. To us it has color, but so successfully does it match the surrounding foliage that its vociferous presence may escape our diligent search.

In spite of our ability to distinguish colors and the excellence with which our eyes identify delicate differences in tone or detailed pattern, our initial reactions to

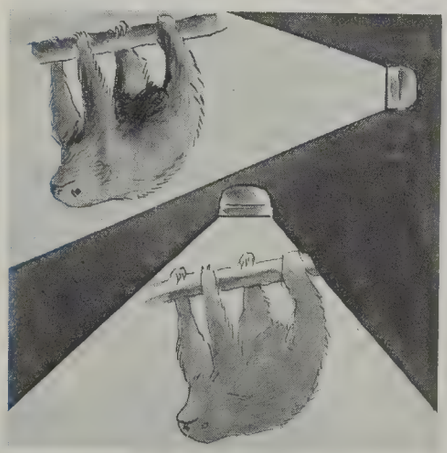
"Disruptive coloration" distracts the eye from the natural outlines of the animal and eliminates the silhouette. Thus the body blends into the background or appears to be broken into disconnected parts

The frog's neat circle of an eye would attract attention were it not for a disruptive stripe of coloring that passes through the eye and continues along the head

Sunlight brightens an animal's back and casts shadows on its underside. Hence, most four footed animals are lighter underneath than on top



A fish lighted from directly in front would also show this conspicuous distribution—darker above and lighter below. But with light coming from the normal direction, the body blends into the background



The sloth, because it lives its life upside down, is fortunate to have the usual pattern reversed

Many animals living in regions that are snow-covered part of the year undergo a change in their fur, like the weasel shown here

▲ ALTHOUGH CLINGING to the bark of a fallen pine tree in full sunlight, this la hawk moth went undetected until, in nervous response to the photographer, insect raised its gray antennae. Previously these feelers had been hidden under sides of the body

most objects are in terms of the most pronounced feature. This is frequently the over-all silhouette. At least one school of fashion design has insisted on student recognition of this basic fact in vision. Everyone has seen how easy it is to confuse new acquaintances when their silhouettes shift from street attire to bathing suit or evening gown. A witness to a robbery may know only that he saw a tall, thin man or a short, fat one. Of course, if the robber wore a bright yellow raincoat, that might be the most conspicuous feature. But even among our close friends, it is often the combination of silhouette and movement that allows recognition. "Yonder comes Antonio. I ken him by his gait."

Birds against the sky often appear only in silhouette, but the naturalist knows them by their flight—the undulations of goldfinch and flicker, the ponderous rhythmic flapping of a string of pelicans, the V's of migrant geese. Insects too small, too indistinctly marked to be seen clearly at a few yards' distance, become hover flies, dung beetles, gnats, bees, caddis flies, or moths according to clues given in their gyrations through the air. This is high contrast—the opposite of camouflage. A silhouette must be destroyed for an animal to disappear. The various means employed all gain this end.

Disruptive Coloration

One effective means of concealment is based on distraction. On its body the animal may wear an irregular pattern of spots, stripes, or other markings that catch the eye and hold it, drawing attention to meaningless details and away from the creature's outline. This eliminates the silhouette, by means of which the whole might be identified. We call this trick "disruptive coloration." It serves to separate a single body into a series of seemingly disconnected, unimportant parts. A fawn in the spotty shade of an open woodland becomes a series of sunlit patches on a brown lump devoid of distinctive contour.

HIS GRASSHOPPER'S SHADOW gives it away, and the strong lighting also shows up its footprints in the sand. In mid-llumination, however, the insect hides its own shadow and hes from view by merely staying still

▲ PAUSING near the burrows of the common beach flea, thi pale, creamy-white spider could be overlooked more easily thar found again. At night it can be located with less difficulty— but only because its eyes reflect the beam of a flashlight

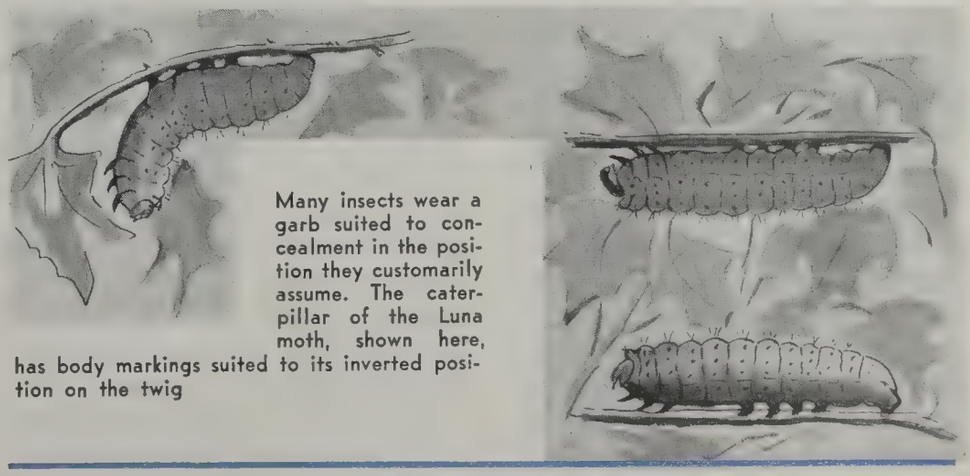
A badger crouching in a field turns toward you a face sharply marked in alternating vertical bands of cream and blackish-brown, and you tend to overlook the outline of the head itself. The coarse camouflage painted on military installations achieves its purpose in the same way. The marks may simulate a number of different objects—none of them clearly recognizable—and distract the eye from the true boundaries. The scaly, mottled color pattern of a water snake, the contrasty feathers of a killdeer, the wing markings of numerous moths and butterflies have this uncanny ability to confuse the eye.

Related to disruptive coloration is another type of pattern. The markings on an animal's back may be continued irregularly and across actual spaces onto thigh and shank so that the appendages merge as one mass when the creature is crouched in repose. Insect wings commonly carry the coloration from one pair to the overlapping set, and among moths the two front wings may meet to form a common contour. These methods introduce continuous disruptive bands and mottlings that bear no reference to the outlines of the separate appendages and serve to conceal the body parts. Perhaps the most spectacular of them are the devices that conceal eyespots. The neat circle draws attention, and a wood frog's eye would have an obvious iris were it not for a pigment stripe through it that continues the dark disruptive band along the amphibian's head. In many insects and fishes the very outline of the body itself is irregular—almost ragged—so that no clear shape stands out to distinguish the creature from its background.

Transparency

A few animals blend with their surroundings wherever they go because their bodies are so transparent that the eye sees through them as through so much cellophane. The Glass-winged Butterfly of the South American tropics is a classical example—one of the few on land. Animals that frequent upper levels of the sea are often diaphanous, such as jellyfishes. Some, like the early stages of the eel and a few prawns, achieve this clear quality in all but a few vital organs, yet they have firm bodies, good sense organs, and active habits. Whether at rest or in motion, these creatures are difficult to discover.

But transparency is difficult to achieve. It is far simpler to match a customary background composed of blended shades of gray or green or buff. Of course, the animal must then keep to the appropriate back-



Many insects wear a garb suited to concealment in the position they customarily assume. The caterpillar of the Luna moth, shown here, has body markings suited to its inverted position on the twig

◂ THE GHOST CRABS that scamper over a sea beach vanish as soon as they stand still if the light is soft. But sharp shadows make them more conspicuous, and . . .

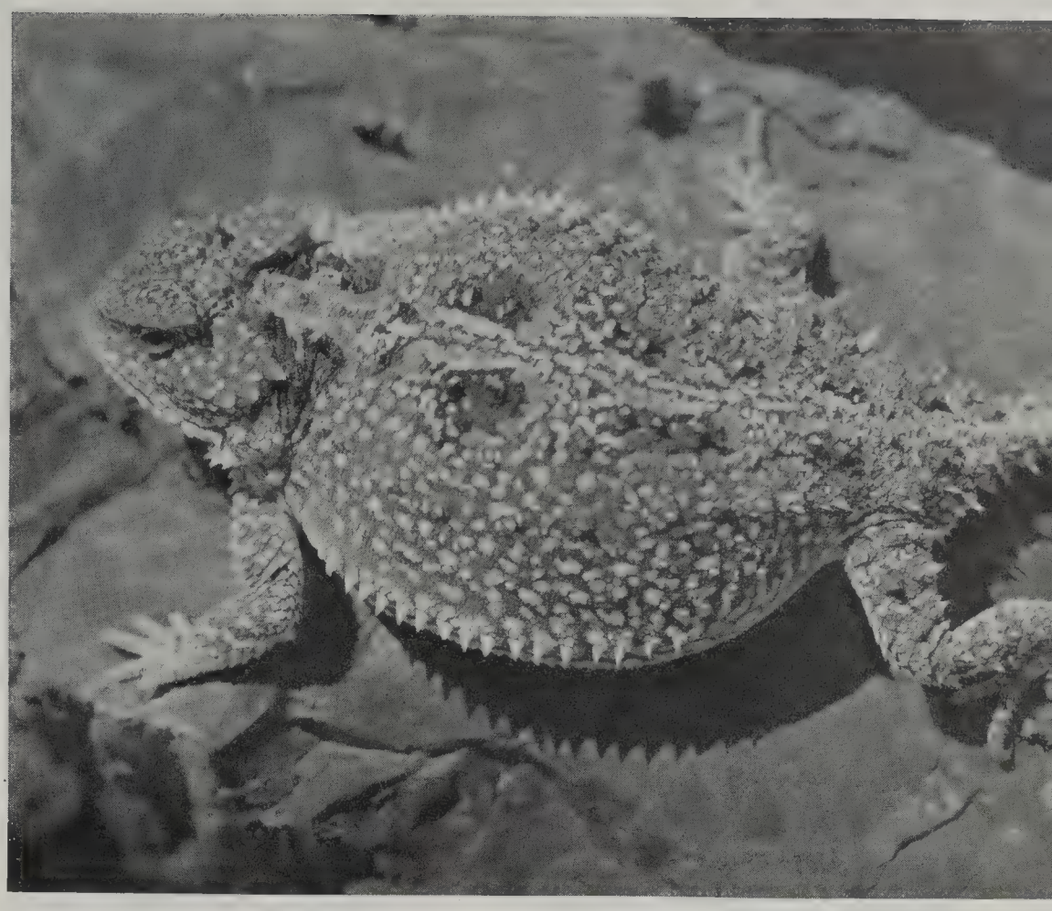
▾ . . . it is their habit to bury themselves in the sand until only the eyes show

ground if it is to remain safe. A green katydid on a scarlet poinsettia leaf would be almost as conspicuous to us as a crow on a snowdrift. The katydid must stay among *green* foliage to escape animals that have color vision. Even a brown, leafy background would destroy the illusion. The pale tiger beetles, the grayish-white spiders, the ghost crabs that scamper over a sea beach vanish as soon as they stand still. Beebe referred to them as "autochthones . . . that . . . drifted about like sand-grain wraiths . . . And when they did move, recognition usually came too late to some fly, which had trespassed on this littoral hunting ground."

The degree to which an animal matches its background is sometimes spectacular. One of the most famous areas where this can be strikingly observed is within a few miles of the site of the first atomic bomb test, in the White Sands National Monument, near Alamogordo, New Mexico. On this strange series of glistening gypsum dunes grow a few yucca plants and a scattering of other herbs. But types of lizards and even insects that are dark in color on land immediately surrounding the White Sands National Monument are represented on the gypsum by white individuals. These scamper from clump to clump of yucca or alight on the dunes and disappear by camouflage.

Even the New Mexican pocket mouse, *Perognathus intermedius,* displays this extraordinary lack of coloration. The individuals on the sand are almost pure white, though they are not albinos since their eyes are black. Those on surrounding rocky soil—the normal habitat for this little rodent—are brown. And close by, on black beds of lava deposited in the not-too-distant past, a third color phase of this same pocket mouse is uniformly blackish except for the pale paws. Other than in their color, no differences have been detected between these representatives of the same species. Like the distinctive grasshoppers that click in the air over each of these three types of terrain, each has achieved an almost perfect match for the very different types of background. The relatively recent origin of these dunes and lava beds gives us pause. It indicates more rapid adaptation in the animals there than might be supposed possible from other illustrations.

Difficulties still confront the animal that duplicates its environmental background. Sunlight brightens its back and casts shadows below its body. To compensate



➤ THE HORNED TOAD'S sawtooth shadow is very conspicuous here. But in its sandy domain it buries its fringes so that shadows and underparts disappear

for this inequality, countershading has developed on many animals. Their backs are darker than the surrounding landscape, and the shine of sunlight there provides no warning clue. Their bellies and flanks are pale, but because these parts receive less illumination, they reflect a matching tone. When you look down upon the black or brownish back of a fish in deep water, it is barely visible against the background, whereas its silvered belly will show a minimum of difference to eyes looking skyward from below. The sides are gradually countershaded, thereby reducing visibility from the side. Only when such a fish swims over a sand bar does it become obvious. Then it stands out sharply from the bottom for any kingfisher to see, while the added light reflected from the sand brightens its undersurfaces until they, too, no longer match when viewed from any angle.

Solely in customary surroundings and illumination is countershading effective. Conventional positions for the body are required also. And animals that regularly spend their lives inverted, like the sloths in tropic trees, are usually pale along their backs and dark over the surfaces they hold toward the sun. The same arrangement is seen among certain bugs, as for example in the back swimmers (*Notonecta*) and in the small crustaceans known as *Scapholoberis*. Often an upside-down habit can even be predicted simply from the examination of such a creature. Thus the Luna and many sphinx moths have caterpillars that are dark green along legs and undersides and pale greenish-white along the back; and if you watch them, you will see that they *do* cling below the leafy twigs on which they customarily browse.

Shadows

A creature that matches its background perfectly may still be obvious on a smooth stretch of sand or a clean tree trunk or leaf, because its shadow traces a telltale black outline around one side. Ghost crabs on a beach would often be almost invisible as they rear high on eight bowed legs except for the conspicuous shadow they cast. Artists often employ shadow lettering in advertising copy, and we read the word that isn't there. The shadows alone enable us to imagine the raised letters. To eliminate its shadow is therefore part of an animal's problem in self-concealment.

Perhaps the simplest way that animals hide their shadows is by squatting or lying at full length on the smooth surface—spreading their bodies and pressing flattened edges against the terrain. Horned toads bury their fringes under the sand, so that shadow and underparts disappear together. The badger's broad, flattened body helps it vanish in a field. Moths on bark employ the same procedure. Ghost crabs quickly twitch their legs and sink their bodies and appendages into the beach until only upright brown eyestalks remain exposed to watch pursuers pass them by. A few lizards and fishes even have extra frills along the sides of the body and tail, which spread out on any supporting surface and eliminate shadows.

In spite of perfect countershading and shadow elimination, the change of seasons can upset camouflage. Thus the snowshoe rabbit must be white in winter and brown in summer. The weasel that follows the rabbit fears the hawk, and except for a jet-black tip to the tail, it turns to ermine white when snow begins to fall, then to an earthy brown when the spring sun melts through to the ground again. The transition periods may be dangerous ones but not for the ptarmigan, whose feathers provide perfect matching throughout the year. In winter, every feather is pure white, but as rocks and moss begin to project through the snow, little patches of brown feathers appear in the plumage. The last few white feathers are shed as the snow vanishes. The reverse sequence protects the

Shadow alone can serve as identification

ptarmigan in the fall. Such changes are needed where seasons are so different. But in Florida and other snow-free states, rabbits and weasels replace their summer fur with winter pelage of the same brown color.

The advantages of matching a background in tone are evident even after dusk, when day vision ends. Color is no longer operative: "At night all cats are gray." Yet owls and other night hunters recognize their prey by sight as well as by sound. A contrasty target scampering across a starlit field is far easier for them to catch than the same sized object camouflaged to match the terrain. Scientists at the University of Michigan tested this in the laboratory and showed that white mice on dark loam or black mice on pale sand lost their lives to a hungry owl long before the ones that suited their background.

The less distinct the contrast between an animal and its background, the closer a naturalist or enemy must come in order to detect its presence. The accompanying diagram demonstrates this principle.

Another way of expressing it is to say that the ability to discriminate contrast depends upon the proportion of the total scene that the object occupies in the observer's eye. Thus if an animal is farther off, it does not need to match its surroundings quite so faithfully to escape detection. Even a large number feeding together in the distance blend sufficiently to disappear.

A striking example of the opposite effect is provided by the Texas bluebonnet. In spring, when carpets of this handsome lupine stretch to the horizon, open woodlands take on a new and startling depth. Under the trees the soft yet brilliant blue extends into far vistas. Perspective shrinks the upright trunks to matchstick dimensions; the bluebonnets go on and on like an azure sea. Yet only a week before, the green of lupine leaves and buds blended with the green of the trees to hem in the scene. The lack of contrast and the loss of detail through distance gave no notion of how far the eye could see. The yonder, without bluebonnets, had disappeared through camouflage.

The Texas scene is a revelation that depends upon color vision. No black-and-white photograph shows the effect adequately. However, many creatures do not possess color vision, and the role this ability plays in natural camouflage lies beyond the scope of the present article.

Control of Pigmentation

Still another type of camouflage is found in certain fishes. In the surface layers of their skin are star-shaped cells containing pigment. In some, most of the pigment is black. This is the case in those common little catfish known as bullheads or mudpouts. The pigment is under nervous control and can either be collected together in the middle of each cell or spread out into the many branches. If concentrated, the tiny black dots can be seen only with a microscope, peppered at intervals over the fish's body. The pinkish-whiteness of the skin shows clearly, and the over-all effect is white. But if the pigment is dispersed, it renders the whole exposed area of the cell a deep black. The overlapping extensions of the many cells effectively cover the body surface, so that the over-all effect is black. The change from concentrated pigment to dispersed pigment may require less than a day. It depends chiefly on what the fish sees. If a mudpout is placed in a black tank, it, too, soon becomes black. If another mudpout is in a white tank, it becomes white. If both are now transferred to a gray tank, both adjust themselves to match the new environment.

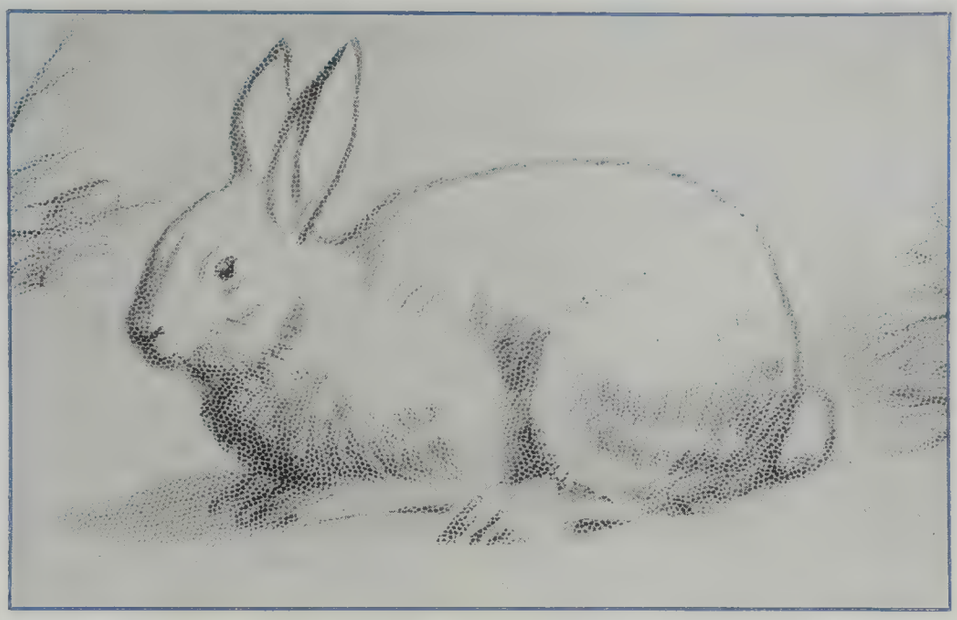
Perhaps the ultimate in this direction is the ability of the flounder and its flatfish relatives, the turbot and halibut. These fishes lie on the bottom, on what originally was one side of their bodies. The young fish has a more normal shape, but one eye migrates to the upper surface as the fish grows. This, together with a strange twisting of the mouth, allows the fish to operate in a seemingly lazy position. But again the eyes and pigment cells on the upper surface are intimately related. Unlike the mudpouts, however, a flounder has in addition to black pigment, a white, a yellow, and a brown—all in an irregular pattern. And not only are the dif-

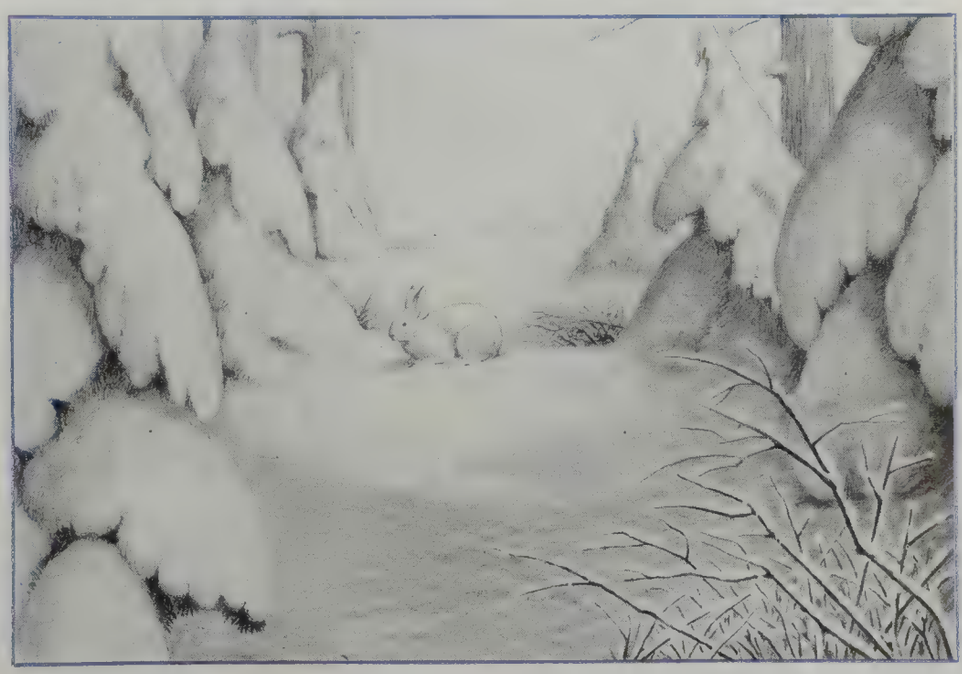
When there is little contrast, the size of the object determines whether you will be able to discern its outline. Note the comparative ease with which you can distinguish the two halves of the larger circle, and the increasing difficulty as the circle becomes smaller

ferent colors under individual control, but even the areas of that uppermost surface are regulated separately. Thus if a flounder is on a sandy bottom, the over-all tone of the pattern matches the brightness of the sand—whether white coral bottom or muddy gray sand or black volcanic particles. The pattern of the pigment also matches the coarseness of the sand by being very minutely speckled. If the flounder is on gravel bottom, on the other hand, specklings on the back are coarser.

The ability of the flounder to match the background seen with its misplaced eyes was investigated by the late Professor F. B. Sumner at the Scripps Oceanographic Institute in La Jolla, California. He placed the fish in special tanks with linoleum patterns for background and recorded photographically the accuracy with which the creatures matched the sequence and coarseness of the squares of black and white on which they lay, quietly waiting for food to swim within capturing distance. If the fish moved, its pattern soon adjusted to the new locality on the linoleum. If transferred to a tank with a different bottom design, the body pigment cells performed again.

A person can but wonder how many thousands or millions of generations were required for these various complex adaptations to reach their present perfection. A slight advantage in terms of survival must have been the test of their permanence, for the less effectively hidden individuals were not so likely to live to produce their kind. Of course, camouflage alone is not enough to guarantee success in the struggle for food and mates. In fact, it would be disastrous for an animal to be so well concealed that its mate could not find it! Yet among the many curious ways in which animals are adapted for success in life, camouflage is one of the most fascinating. It is also a study in which a great deal of valuable information can be added by interested observers.





Since apparent size is dependent upon distance, an animal does not need to match its background so closely if it keeps far from other creatures

HIGHBOYS

Meet the incredible giraffe — an animated watchtower that has difficulty coming down to earth for a drink and sometimes lets its curiosity get the better of it

By KEN SCOTT, JR.
General Curator, San Diego Zoo

THEY stood browsing among the acacias, their spotted, sinuous necks arching above the trees. Gray tongues, wet and serpent-like, sought out the freshest, tenderest leaves and tore them from the branches. Tufted tails switched languidly from side to side. Even though my car was now only 200 yards from where these animated skyscrapers were stripping their lunch from the trees, they seemed entirely unaware of my presence.

The scene had an air of unreality about it, a stark sort of unreality that sprang, oddly enough, from familiarity. Although I had never laid eyes on the spot before, I knew it as well as my own street and number. It was a museum diorama come to life, and I had seen it in replica a hundred times before, as it waited eternally for the subtle touch of life.

Now, here before me, it breathed and moved and whispered — the golden infinity of Kenya's Athi Plains, the parasol-topped trees with their sparse, thorny foliage, the zebras, the wildebeests, the "Tommies," and — the giraffes!

The giraffes were hardest of all to accept as living flesh and blood. Yet there they stood, placidly munching away on acacia leaves with no inkling of the awe I felt.

Giraffes had long been favorites of mine in the San Diego Zoo, ever since, in fact, we had received our first pair in 1938. I had seen giraffes in circuses and other zoos before, but, when our own zoo specimens emerged from the crates in which they had been shipped from Uganda, I felt certain that nowhere in creation could there be two more beautiful creatures than these, smudged and travel-weary though they were.

I marveled at their towering height and the fluid grace with which they glided in their pacing gait; at the quiet dignity with which they accepted the first uncertain ministrations of their new keeper; and perhaps most of all at the disarming, soul-searching quality of their gentle brown eyes. My reaction was an immediate attachment, and it is one from which I have never recovered. The novelty of having a pair of giraffes in our own zoo soon wore off, but the affection and interest I originally felt for them has grown conversely, multiplying many times over with the birth of each new infant calf to the adult pair.

The same attachment, I found, held true for the wild giraffes in Africa. Unconfined by museum glass or zoo barricade, they were more amazing, more wonderful than ever.

The first group I saw was a small one, just inside the gate of Nairobi

Photo by Quentin Keynes

◀ THE GRACEFUL GIRAFFE lives peaceably with its kind and bears no ill-will toward other types of animals. Its disarming, soul-searching, gentle brown eyes endear it to the zoo keeper, though it can "kick in all directions at once"

Photo by Quentin Keynes

▲ Silhouette of Africa: giraffes browsing on the Athi Plains in Kenya Colony. The tallest living animal symbolizes Africa more than any other big game animal, for nothing like it roams any other land

National Park on the Athi Plains. There were four of them: a bull, two cows, and a half-grown calf; and I came upon them while they were in the midst of their lunch (both figuratively and literally speaking). They fed from the crown of the same tree, spaced at intervals around it like any family foursome about the dinner table.

Behind them in the distance lay the outskirts of Nairobi itself, and only a few hundred yards away traffic bustled up and down the busy Magadi Highway. The proximity of civilization had little apparent effect on them. It was obvious that the protection they had enjoyed for a number of years had won their confidence to an astonishing degree.

As my car crawled toward them, they paused in their feeding from time to time, rearing their heads briefly before resuming their meal. Their curiosity was at first quite casual and only momentary. But as I drove closer, they watched more and fed less. Finally, with an air of, "Oh, well, we were through eating anyway," they sauntered off.

A short distance away, they stopped and turned and stood watching me. Patiently, they chewed their cuds and awaited my departure with a concern that was due more to annoyance than to fright.

As often as possible during my stay in the Nairobi area, I drove out to the park, which, conveniently enough, is situated only a few minutes from the center of town. On each occasion, I found the same giraffe family, and they were never far from the acacia clump near the park entrance. That first meal was not the only one I interrupted, but sometimes my visits were more conveniently timed. I often saw them in the open, half asleep and drinking-in the morning sun, and sometimes I came upon them standing in the road.

Fortunately both for them and for the motorists, the speed limit in the sanctuary is fifteen miles an hour, a pace that gives the giraffes ample time to make a graceful exit. On the open highway where speed is unlimited, giraffes constitute a considerable hazard, particularly at night.

I was to see many giraffe herds during the ensuing weeks, but I never came upon a group without experiencing that initial reaction of combined awe and incredulity. I am still almost ready to agree with the man who insisted, "There ain't no sech animal!"

The giraffe observations and notes I had opportunity to record in Africa could in no way be construed as scientific studies. But in reviewing them, I find that, sifted and unscrambled, organized and digested, they do perhaps provide a key to the character and behavior of this unique creation of nature. Certain traits, I find, are referred to over and over again, so repeatedly in fact that one cannot help drawing certain general conclusions. And of these traits, the giraffe's *laissez-faire* approach to living tops the list.

There exists no less offensive a beast than the giraffe. It lives peaceably with its kind for the most part and bears not the slightest degree of ill-will toward other kinds of animals—both of which, as character recommendations, are more than can be said about the majority of people! Yet despite such inoffensiveness (or perhaps because of it), the lofty giraffe is sometimes an underdog. Because of its size, its enemies are naturally few in kind, but what they lack in variety they make up for in violence—and Man heads the list.

For some unaccountable reason, the giraffe is a favorite of trophy hunters. Its head, stuffed with papier mâché and a pair of glassy, expressionless eyes, decorates many a sportsman's den—and I use the word "sportsman" loosely, since walking up to a giraffe in the field and dropping it in its tracks must involve all the excitement and danger of bagging a Jersey heifer in a dairy yard.

Both the lion and the leopard occasionally kill giraffes, but they do it merely to appease their hunger. A single giraffe can provide a hearty meal for an entire pride of lions as well as the jackals, hyenas, and

Photo by G. E. Kirkpatrick

▲At zoos the giraffe is always a favorite attraction. The animal is well known for its curiosity about everything, including people

vultures that move in as soon as the big cats have eaten their fill.

A giraffe has no means of defense unless, as one zoo worker put it, you say it is the only animal that can kick in all four directions at the same time. While this statement is a slight exaggeration, it is nonetheless true that anyone working with a giraffe in captivity had best keep an eye on its hoofs or he is likely to be reminded of them in a most disconcerting manner. In the wild, a hunter never gets close enough to a giraffe to be in a position to worry about being kicked.

The giraffe's horns, small, knob-tipped and hair-covered, are of little value in defending their bearer against predators. To my knowledge, the only use to which they are put is in the occasional combats that occur between two males. At such times, one male lowers his head and shoves his horns between the forelegs of the other. Then, with a mighty heave, he rears his head, attempting to throw his adversary back on his haunches.

The long neck of the giraffe, incredible though the contention may seem, contains exactly the same number of vertebrae that grace the human neck. There are seven of them, but the degree of their elongation is without equal, and they serve their bearer in good stead.

The giraffe's neck constitutes a watchtower. This, combined with excellent vision and a good sense of smell, enables the animal to observe potential danger from a considerable distance. Unfortunately, the giraffe's judgment as to what constitutes potential danger and what does not is poor. Being cursed with an innate and irrepressible curiosity, the giraffe is often attracted by something that should scare the living daylights out of it.

This foolhardy characteristic is particularly evident in young animals. I have watched a mother giraffe pace excitedly back and forth while her precious calf edged closer, step by step, to where I stood motionless. No amount of snorting or head tossing by the alarmed parent had the slightest effect on the youngster, and only some slight but sudden movement on my part sent it rocking home to mother.

Among the most remarkable habits ascribed to the giraffe is that of the communal nursery. Some authors discredit the story entirely, describing it smugly as an old wives' tale. However, I have seen a single, mature giraffe cow surrounded by as many as nine youngsters, all under a year old—with not another adult giraffe within a mile in any direction. The gestation period of a giraffe is approximately fifteen months, and only one calf is customarily born at a time—never more than two. Since "novemtuplets" would be entirely out of the question, the only explanation I can offer for such an aggregation is the communal nursery theory.

Giraffes are generally sociable animals, with only an occasional misfit who appears to live alone and like it. Giraffe herds may include anywhere from half a dozen individuals to a hundred. The largest herd I observed consisted of approximately seventy members.

This group was led by a magnificent, black-spotted bull. His neck was thick and muscular, and his forehead bulged with the protuberances that characterize most mature giraffe bulls. There were several other bulls in the herd but not one that even began to rival him in height, bulk, or coloration.

Yet impressive though this monster was, he was still not the most noteworthy member of the herd. That distinction belonged beyond doubt to a small and rather puny individual.

It was an albino, with reddish and poorly defined spots and interspaces of dusty white. Because of its poor vision, the albino always sought the center of the herd, apparently depending upon the behavior of the other animals to warn it when danger was imminent. Try as I might, I could not approach it closely enough to obtain a satisfactory picture. Invariably it was surrounded, and sometimes completely hidden, by its herdmates.

The herd permitted me to walk within 300 or 400 feet of its outermost member. At this distance, however, the entire group began to move away. The retreat was executed not hurriedly, not nervously, but with a leisurely dignity. Only the leader remained steadfast, standing broadside and outlined against the sky like a massive statue. Finally, when he appeared to be satisfied that his compatriots had retreated to a safe distance, he too walked sedately away, serving as rear guard.

Giraffes are strictly browsing animals, feeding from the tops of acacias and other trees and shrubs of a convenient height. Their table manners are beyond reproach and quite in keeping with the graceful behavior that generally characterizes them. Drinking, however, is another matter.

When a giraffe drinks, it is forced to toss both grace and caution to the winds. In lowering its head to the water level, it becomes the ultimate in awkwardness. Sometimes it spreads its forelegs, stiffly and straight, at right angles to one another, and shifts its front feet farther and farther apart in shuddering jerks until at last it can reach the water. At other times it places the feet slightly ahead of the body and bends its forelegs forward and down, spider fashion, until the head is low enough to reach the water. In either case, the process is a slow and uncertain one. And once the animal's thirst is slaked, the recovery of its normal standing position is just as awkward.

Consequently, the giraffe is understandably reluctant to visit the water hole and does so only when it is absolutely certain that no danger lurks near by. If some strange scent disturbs the giraffe as it approaches the water hole, it refuses to drink until the scent is gone or its thirst becomes unbearable. It subsists in the meantime on what scant fluids it can glean from its food. Like the camel, the giraffe has been accredited with remarkable powers of abstinence. It can forego drinking for 40 or 50 days, or so the story goes! Such reports come under the heading of gross exaggeration, but it is safe to say that the giraffe may, and often does, go several days without water.

Of all the myths concerning the giraffe, that which is most commonly repeated and most widely believed is that the creature is mute—that it lacks any vestige of vocal equipment. This is far from the truth, for the giraffe does have a larynx—a poorly developed and seldom utilized one, to be sure—but still a larynx. So far as I know, there are no authoritative reports of the vocalizing efforts of wild giraffes, but zoo specimens have been heard to "moo" softly. Thus, as Mr. George G. Goodwin of the American Museum has been quoted as saying, the giraffe is not mute, it is merely reticent.

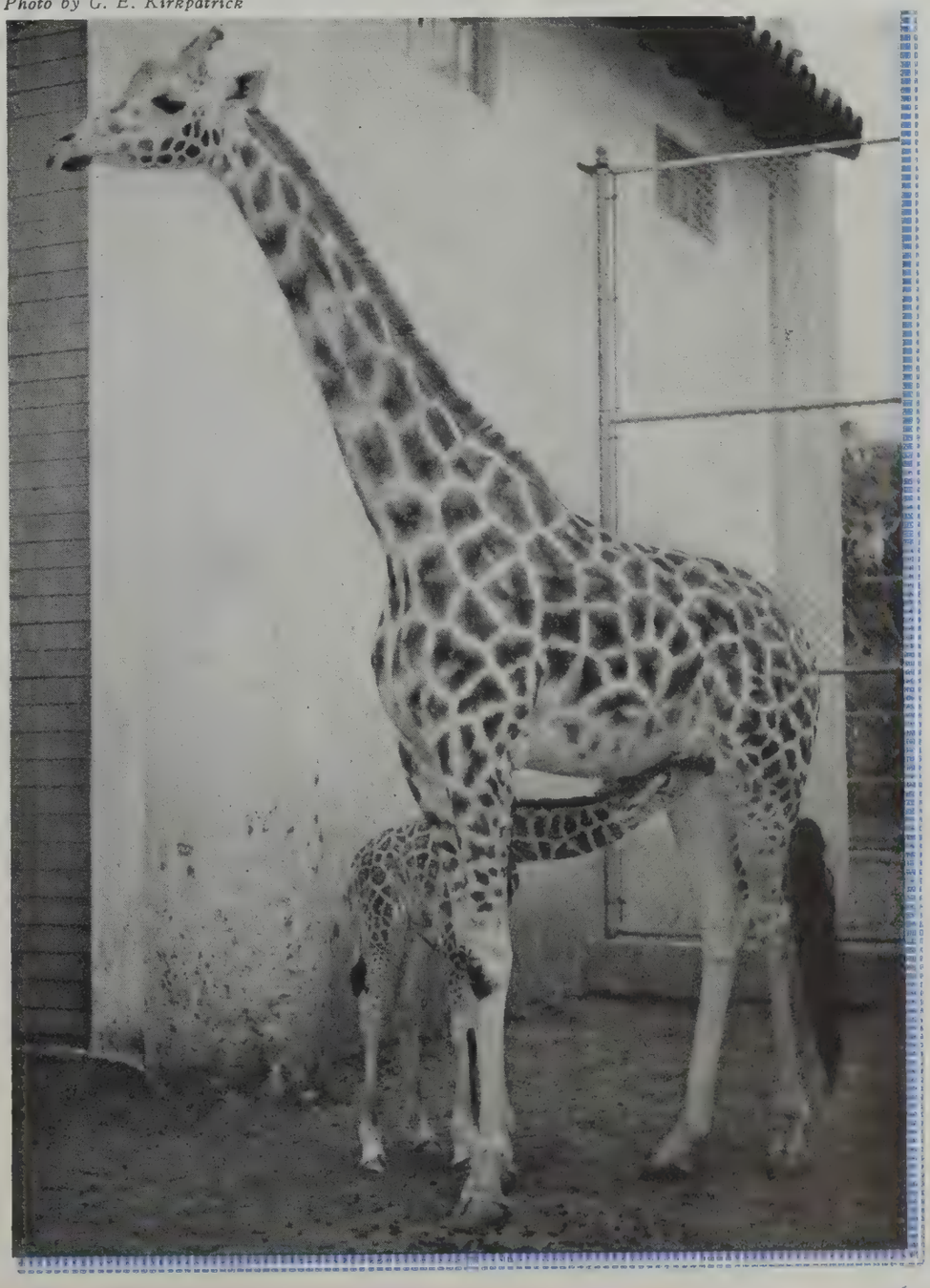
There are several easily distinguishable types of giraffe. There is the Masai giraffe, with its brown maple-leaf blotches against a background of beige. Then there is the reticulated or Somali giraffe, with its red coat and network of immaculate white. And the Uganda giraffe has three bony protuberances in addition to the two bonafide horns, which have caused it to become known as the "five-horned" giraffe. Each of these and half a dozen other described forms have some individual claim for physical distinction. But whether the various forms are merely local races or constitute valid species is a matter worthy of considerable research.

The problem, however, is one that concerns only the taxonomist. As far as the African tourist is concerned, a giraffe is a giraffe, and nothing else matters. Here stands a creature that symbolizes Africa perhaps more than any other of the Dark Continent's big game mammals. Nothing like it roams any other part of the world. It is and has been, throughout historic times, confined to Africa.

The late Martin Johnson, in selecting a color scheme for one of his amphibious planes, chose a giraffe-hide pattern. The choice was not the result of a mere whim. The plane was to be christened "The Spirit of Africa," and what design could be more appropriate than that of the giraffe!

▼ A UGANDA GIRAFFE with her newborn calf. The female bears only one calf at a time—never more than two

Photo by G. E. Kirkpatrick



▲ THE REPLICA of the crucifix, complete with halo, is on the underside of the skull. Venerated for centuries, these skulls are sold in curio shops around the Caribbean. The authentic dissections from which these photographs were made represent the artistry of Mr. Theodore I. Schneider. Mr. Schneider undertook this exacting work as a hobby, but he became so distinguished a master of it that the American Museum is privileged to have several examples of his work among its exhibits

The Cr

Every sea catfish carri
of the Easter Season,
gious lore of many

By N. J. BERRILL
McGill University

COLUMBUS was a deeply religious man. When he crossed the ocean for the third time, the first land he saw he named Trinidad after the Holy Trinity. Some days later his ship sailed past the mouth of the Orinoco into the Gulf of Paria. Fish of many kinds were caught and eaten, and the sea catfish was certainly among them. But the heads and bones must have been thrown away, for Columbus by this time was convinced he was getting close to the lost Eden, the Earthly Paradise, and he would not have overlooked the Sign of the Cross. Had he himself seen the skull of the Crucifix Fish, surely his mood would have prompted him to speak of it in his letter to their Royal Highnesses.

In any of the coastal towns of South America and through the West Indies you can find these skulls in any curio shop. People are said to hang them on the wall in place of a crucifix, and they have been venerated for centuries as charms against danger and sickness. The lower jaw is not included. If you hold the skull in your hand with the underneath side uppermost, the bones of the roof of the mouth form a crucifix. The cross is there, and so is the figure of Christ. You may even discern what looks like a crown or halo.

Once the symbol of the cross itself was recognized, almost every other bone in the skull was brought into the picture. The peculiar bones that look like the halo have also

fix Fish

a remarkable reminder
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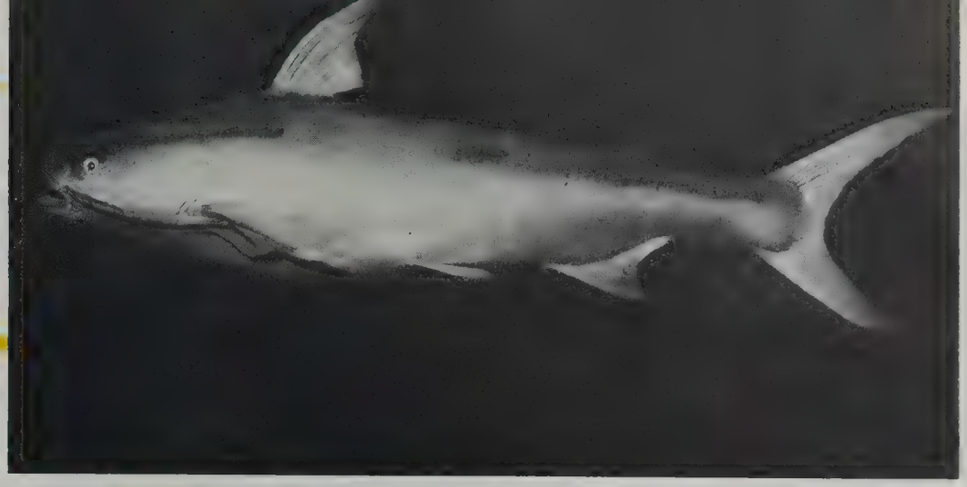
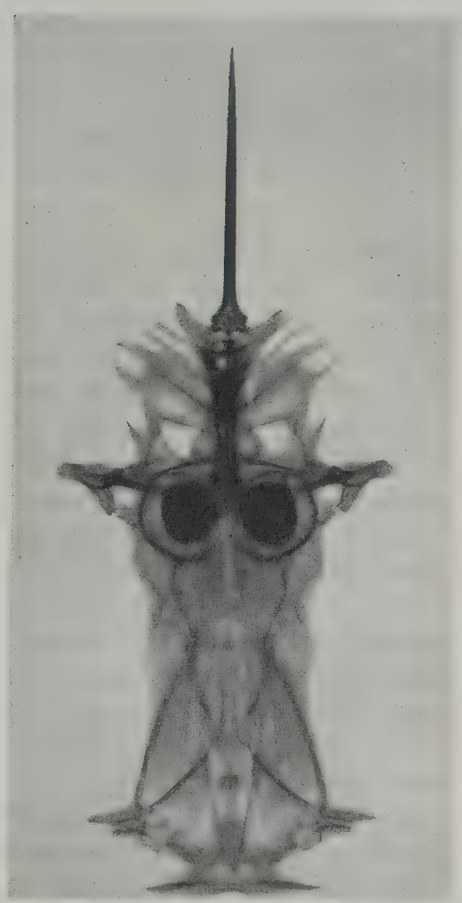


▲ NOTHING in the external appearance of this bewhiskered fish would suggest the hidden beauties of its internal architecture

been interpreted as the steps to the cross. If the skull is turned over, you see the breastplate and the spear of the Roman soldier; and if you shake the skull, you hear two objects inside rattle loudly — the dice with which the soldiers cast lots for the garments of our Lord. An account of the fish written in 1789 states that "when the bones of the head are separated, each represents some one of the instruments of the Passion of our Redeemer, forming spear, cross, nails, etc." Others have seen the upper side to be a hooded monk with outstretched arms.

Such is the symbolism. How, then, do these strangely shaped bones serve the fish? The robes of the monk are the skin bones of the head fused together to protect the underlying brain. The two largest spaces between the skirt of the robe and the feet of the monk are where the organs of smell lie tucked below the surface. The post of the cross is the solid axis underlying the brain and extending the rigid axis of the head to the snout itself.

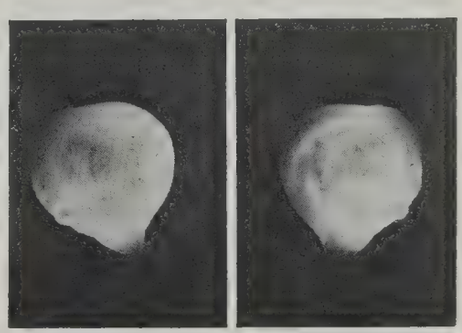
When the skull is shaken, the dice rattle. These are the ear stones, or otoliths, hidden away in their boxes just below the arms of the figure. Bone must be cut away to get them out. As ear stones they serve the fish as part of the mechanism for static balance. They are loose, but they grow as the fish grows, fast in summer, slow in winter, so that when they are cut through they show annual rings like tree rings, indicating the age of the fish.



X-ray by Dr. Sidney Rubenfeld

◀ WHEN THE SKULL IS SHAKEN, there is a loud rattling noise, caused by two ear stones, which have been interpreted as symbolizing the dice with which the soldiers cast lots for the garments of Christ. The ear stones can be seen as two dark spots in this remarkable X-ray photograph

▼ THOUGH THE EAR STONES are loose in their capsules, they grow as the fish grows, forming annual growth rings somewhat like those in a tree. These were taken from a fish 4 or 5 years old



The halo consists of three pairs of bones, although one pair dominates. These are the Weberian ossicles, so-named after their discoverer, and they act as a chain of bones connecting the air bladder of the fish with the back of the ear cavities, in the same way that the hammer, anvil, and stirrup in our middle ear connect the eardrum with the sense organ itself, the inner ear.

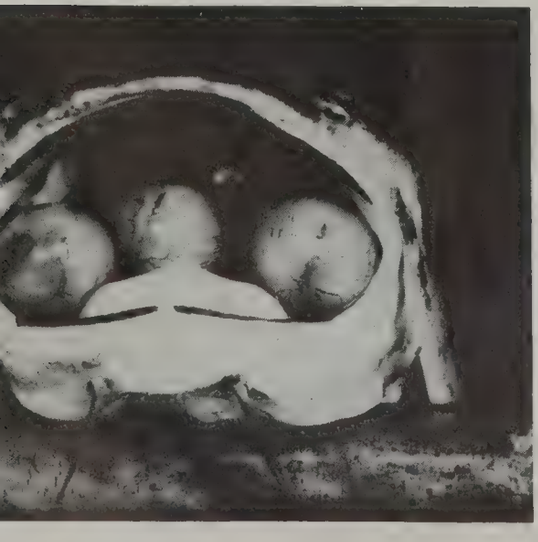
To speak of the ear is a little confusing, for in our own case and that of all land vertebrates the ear is a double organ, part for balance and part for hearing. The fish lacks the hearing part as we know it. But catfish and their closer relatives have independently evolved something comparable to it. The ossicles have been made, long ago, from parts of vertebrae of the neck, and they connect the ear capsules with the air bladder, so that a sense of hearing of a kind has been added to the organ of balance. Recent experiments, in which loaches were made to respond to a dinner bell, flute, or other sound, suggest that fishes detect water-borne vibrations, whether they be called "sound" waves or not.

Most zoologists believe that the

➤ SYMBOLS of the spear and breastplate of the Roman soldiers have been seen in the movable spine that supports the fish's dorsal fin and in the shield-shaped bone at its base. At left, you see a small sliding bone that works like a bayonet lock to keep the spine in an erect position. At right, in this illustration, the spine is removed from its base

➤ THE SKULL with the spine raised

air bladder of a fish was originally one of a pair of lungs such as the lungfishes retain to this day. In most bony fishes the bladder is completely sealed off from the outside of the animal and functions as a hydrostatic organ. Some fishes, however, have stopped short of this, and in the catfishes especially, which include the Crucifix Fish, the bladder keeps its open connection with the throat. Now, while the air bladder probably has its hydrostatic function, the open tube enables the fish to grunt. This, in its own way, is a voice. But it is very difficult to discover how much this organ may be used to call other catfish, especially during the mating season, and how much it may be used to register changing pressure related to the depth of the fish in the water.



Turning again to the upper side of the crucifix skull, we have left the breastplate and the spear. The breastplate is another skin bone. It extends backward from the skull and serves partly to protect the animal. But it also provides attachment for part of the great muscle system that brings about the swimming movement of the body. It is more than that, however, and here we need to look at the fish from the side and more from the point of view of a sailor or fisherman.

The Sea Catfish has another name, more akin to the sea and ships and the wind than to the mystic symbolism of the Christian Church. It is the Gaff-topsail Catfish, and according to the Oxford Dictionary, a gaff is a "spar extending the top of a fore-and-aft sail not set on stays," a spar that can be raised and lowered.

The spear is the gaff or spar and is actually a great dorsal spine that forms the fore-edge of the dorsal fin or topsail. The muscles that raise or lower the gaff pass down between the prongs of the breastplate and are attached to the sturdy growth of bone that rises from the back of the lower skull to the breastplate like a mast between decks. A short spine in front, at the base of the long spine, is "a nail of the cross" and acts as a stop to prevent the gaff from tipping too far forward.

Like the catfish of the rivers and lakes, sea catfish stay close to the bottom, grubbing along with barbels or whiskers probing and trailing, sensitized both by touch and taste to detect edible morsels. They stay close to the coast and frequent the estuaries and bays and mud flats near the mouths of rivers — regions where water is generally murky with suspended mud. Living as they do, sight is of no more value than other senses, and taste and touch loom as large in the brain as on the face.

Living as they do, these fish have special problems in reproduction. Muddy water is no place for fish fry to find the special small food organisms they need, and a mud bottom is a hopeless place on which to deposit eggs. So catfishes of all kinds, in the course of time, have done something about it. According to Dr. E. W. Gudger, the first steps can be seen in the common yellow catfish of the rivers. Their eggs are large, as fish eggs

➤ FROM SPRING UNTIL SUMMER, the father fish carries the eggs in his mouth, as shown here. His appetite disappears, and the young fish swim around in his mouth until they are about four inches long

▲ WHEN LOWERED, the spine lies parallel to the fish's back just behind the neck

go, and they are laid in a sort of nest. But this alone is not enough. The parent keeps the water in movement, and as a final and potent gesture, the male periodically takes the developing eggs into his mouth and then blows them out with some force, keeping up the practice until the fry can swim freely. In this way they are kept clean and healthy, and at the same time the father realizes an instinctive paternity and refrains from swallowing his offspring.

So much for a river catfish. When it comes to a question of laying marble-sized eggs on marine mud flats, the problem becomes greater, for in addition to the smothering mud is the even greater menace of the voracious blue crabs. Therefore, sea catfish and some others have pushed paternal care to the limit. The Gaff-topsail of the Atlantic coast is typical. The eggs are golden yellow and average about three-quarters of an inch in diameter, and the female lays anything up to about seventy of them. These are large eggs from any point of view, and they can develop into small fish two inches or more in length before feeding becomes necessary. So if they can survive at all, they get an extremely good start in life. But the larger, more obvious, and heavier the eggs, the more protection they need, and in this case the male takes them into his mouth after they have been fertilized and for about ten weeks thereafter becomes a veritable perambulator. His mouth enlarges in anticipation of the nursery it has to be, and his appetite disappears entirely. Then, from spring into summer, the developing eggs are kept safe. They hatch when the embryo is about an inch and three-quarters long, but even then they stay within the bounds of safety. Dr. Gudger believes they feed on the microscopic crustaceans drawn into the father's mouth with the water he takes in for breathing. Apparently the young fish filter them out by their own finely-set gill rakers, for they do not leave their father to live their own lives until they have spent some weeks skating and swimming around in the mouth cavity and have grown to a length of about four inches! Then presumably they are fairly safe, even from their more or less cannibalistic mother, and once again the father can recover his desire for food and go about his own respectable masculine business.

◀ THE CRUCIFIX is located on the underside of the skull, with the arms of the cross near the neck

The Bird that Baffled

For half a century, bird students wondered where the Kirtland's Warbler disappeared in summer to lay its eggs

NORTH of Muskegon, we pulled off the highway and into a tourist court set among oaks near the eastern shore of Lake Michigan. We were less than half a day's run from the jack pine barrens of north-central Michigan, home of the Kirtland's Warbler, that rare and restricted bird we had driven a thousand miles to see.

That evening my wife and I thumbed once more through our bird guides, memorizing the habits and field marks of this songbird of the jack pines. Only in Oscoda, Crawford, and Iosco counties—with scattering records from adjoining counties; only in an area about 60 miles across and 100 miles long; only here, in all the world, is the Kirtland's Warbler known to nest. It breeds in the sandy jack pine barrens where new trees have sprung up in the wake of a fire. Not until these pines are five feet high do the warblers accept an area; as soon as the trees reach about eighteen feet, they abandon it. Thus each successive area is acceptable as a breeding ground for only about fifteen years. The Kirtland's Warbler depends, literally, upon forest fires for its nesting sites.

The riddles surrounding the life of this curiously restricted bird have stirred the interest of ornithologists ever since it first became known to science in 1852. On May 13, of the previous year, Charles Pease shot a small bird in a treetop near Cleveland, Ohio. The little migrant was unknown to him and also to his father-in-law, Dr. Jared Potter Kirtland, a Cleveland physician and naturalist of national standing. The bird was named *Sylvicola kirtlandii*, in honor of Kirtland, by Dr. Spencer Baird, Secretary of the Smithsonian Institution, in Washington, D.C. This has since been changed to *Dendroica kirtlandii*. The Cleveland physician, a friend of Agassiz and other celebrated naturalists of his time, also had his name bestowed upon a mollusk, a snake, a fossil plant, and a town. Kirtland, Ohio, a community east of Cleveland, derived its name from the same source as the Kirtland's Warbler.

About a decade after the first specimen was collected, a second one was taken—also at Cleveland. Then, in 1865, Dr. Baird made a surprising discovery. In checking over some specimens collected by S. Cabot, Jr., on a voyage to Yucatán, he came upon the skin of a Kirtland's Warbler. It had been shot at sea, near the island of Abaco, in the Bahamas, about 1840. This was a dozen years before the type specimen had been collected near Cleveland. For a quarter of a century the little bird had gone unnoticed among the many specimens result-

HAROLD MAYFIELD, who has
en assisting Dr. Josselyn Van
ne in studying this bird. The
rtland's Warbler will not ac-
ot an area before the trees reach
oulder height or after they are
feet tall, as at right. Thus, it is
pendent upon forest fires

ontinent

By

EDWIN WAY TEALE

All photographs by the author

▶ THE MALE Kirtland's Warbler is a striking bird—lemon-yellow beneath, blue-gray and heavily streaked above. It has a distinctive black mask running back along the side of its face

ing from the Cabot expedition, until Dr. Baird discovered it. His find gave a clue to the wintering ground of the warbler decades before its home and breeding area were known.

So matters stood for upwards of half a century. Single specimens were collected at rare intervals in South Carolina, Ohio, southern Michigan, Missouri, and—in winter—on several islands of the Bahamas. But, during every summer, the warbler disappeared. Ornithologists speculated on its breeding grounds. Some thought it nested in Alaska, others picked Labrador, still others maintained it bred on the tundras of northern Canada. As late as the fall of 1898, Dr. Frank M. Chapman was writing in *The Auk* that he believed the warbler nested in the region of Hudson Bay. "Owing to its rarity and the remoteness of its probable breeding range," he added, "its nest and eggs will doubtless long remain unknown."

That prediction, however, was soon upset. By 1903, nest, eggs, and breeding grounds had all been located. Norman A. Wood, Curator of the ornithological collection at the University of Michigan Museum, in Ann Arbor, had come to the conclusion that the Kirtland's Warbler nested somewhere in the wild areas of northern Michigan. Early in June, 1903, his assistant, E. H. Frothingham, returned from a fishing trip on the Au Sable River with a story of a bird song he had never heard before and a specimen shot by his companion, T. G. Gale. Wood recognized the bird as the Kirtland's Warbler. A few days later, he was riding a Toledo, Ann Arbor, and Northern Railroad train to Roscommon, 35 miles by road from the spot where the song had been heard. This little lumber town, which he reached at four o'clock in the morning, was the nearest point on the railroad to his objective. There he rented a rowboat, and by seven that morning he was floating on the swift current down the south branch of the Au Sable River, starting on a 60-mile rowboat ride that would bring him to a new steel bridge spanning the river west of Mio in Oscoda County. This bridge was the landmark Frothingham had given him.

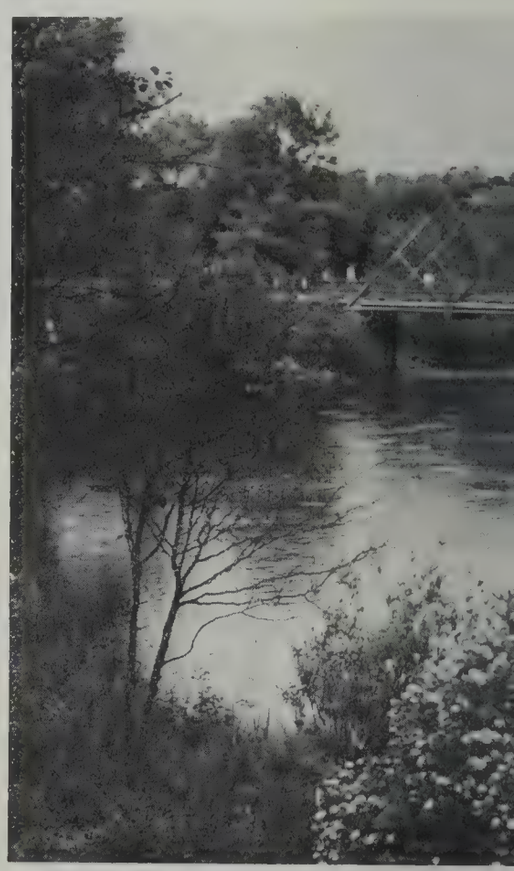
All day, Wood drifted downstream through wild and interesting country. He listed 40 species of birds before evening. After a night spent at a fishing camp, 35 miles downstream from Roscommon, he started again. On the alert for "sweepers"—cedars toppled into the river through undercutting of the banks – he made rapid progress down the main stream of the river. In open stretches he got out his tackle and caught trout and grayling as he drifted along. By six o'clock, he was hauling his boat

ashore near the steel bridge. The date was the first of July.

Seven days of searching followed. Half a dozen Kirtland's Warblers were heard singing, and one male was collected. But the nest eluded him. Then he came to a large tract of several hundred acres that had been burned over six years before and was now covered with young jack pines and a low growth of sweet fern, blueberries, and trailing arbutus. Here Wood came to the end of his quest. Later, he wrote of that moment: "It can be imagined with what delight I beheld the first nest of this rare bird ever seen and with what eagerness I dropped to my knees beside it to make a closer examination of its contents." The nest, about two inches deep and two inches across, held two young birds and a perfect egg. He discovered a second nest over the line in Crawford County. On July 16, a day so cold in Oscoda County that an overcoat was needed, Wood loaded his nests and the material he had collected into a farmer's rig and started on the laborious 35-mile drive over lumber roads to Roscommon. He had solved the long mystery of the summer home and the breeding ground of the Kirtland's Warbler.

The steel bridge that formed Wood's landmark still stands. We drove across it on our first day in Oscoda County. That day we cruised endlessly over the yellow-white sand roads that also form fire lanes. They run, a mile apart, in straight lines that cut the county into a great grid, each block of forest one mile square. Oscoda is still the most sparsely settled county in Michigan. It contains no railroad, no coal yard. Its few scattered communities all originated as lumber camps. Up until the time of World War II, it had no bus line, no doctor, no dentist. We saw deer trails forming straight lines across the sand roads as we drove along, often racked by stretches of washboard ruts and always followed by a moving cloud of dust. With straining ears, we listened for the unfamiliar song of the Kirtland's Warbler. We heard the trill of Pine Warblers, the lisp of Cedar Waxwings, the upscale "zee-zee-zee" of Prairie Warblers, and the curious, drawling, insect-like "buzz–buzz–buzz, buzz, buzz" of Clay-colored Sparrows. But nowhere did we catch anything resembling the song of the bird we were seeking.

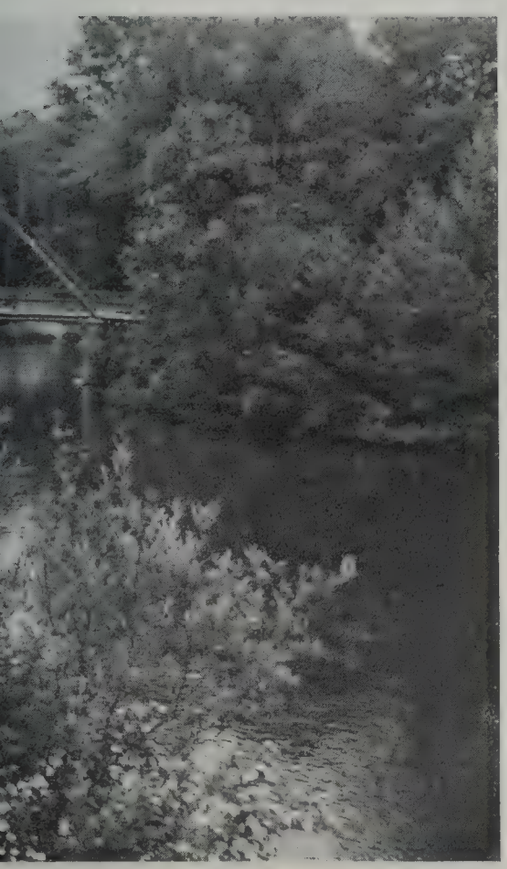
We assumed we were missing the



▲ WHEN, in 1903, E. H. Frothingham reported a strange bird in a wild section of Michigan, Norman A. Wood knew the warbler had been located. This bridge was the landmark that led him to its haunts

◀ ONLY FOR ABOUT fifteen years will the Kirtland's Warbler nest in a given section. During that time the trees of a burned-over tract grow from the five-foot minimum to the eighteen-foot maximum

song. But, later, Roger Tory Peterson told me he had had a similar experience. He drove all day without hearing the bird; then, after he had heard it and was familiar with the song, he drove back over the same roads. He had not missed the song; the birds just were not there. They nest in scattered colonies, often miles apart. By evening, on that day of frustration, we were pouncing on fragments of familiar bird songs, slamming on the brakes even at unusual squeakings of the car. Completely discouraged, we turned into Hinchman Acres Camp, on the edge of Mio. And there Lady Luck appeared in the form of a small girl with a cowbird fledgling riding on her forefinger.



She came into the office as I was signing for a cabin. The manager explained:

"A lot of people here are interested in birds. We've got two bird doctors in camp, right now. They come up every year in June."

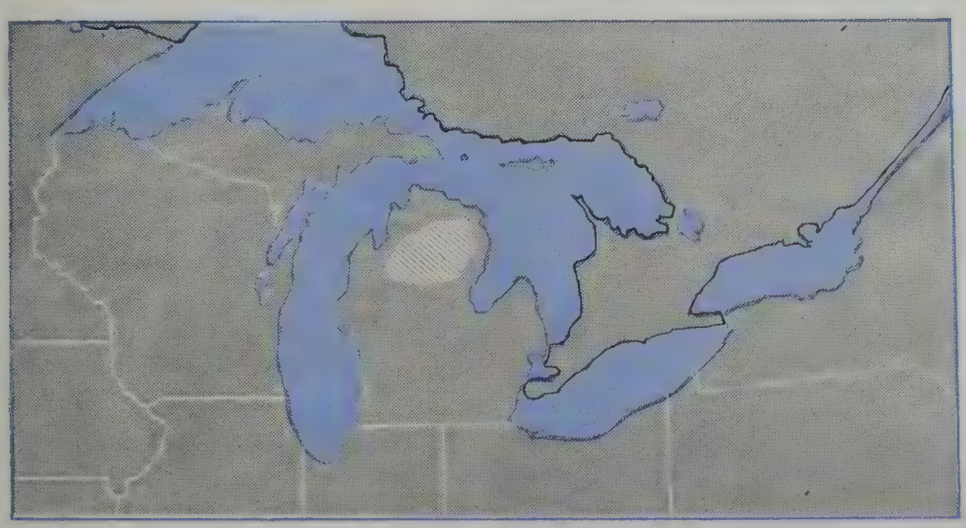
The "bird doctors" proved to be Dr. Josselyn Van Tyne, of the University of Michigan, and Harold Mayfield, a friend of mine from Toledo, Ohio. Dr. Van Tyne, outstanding student of the Kirtland's Warbler, has spent years studying the bird intensively. During ten successive seasons, he has spent at least twenty days in June—from five in the morning until six at night—observing the nesting warblers from a blind. For seven of those ten years, Mayfield has assisted him in the work.

That night, the four of us ate at Kookie's Kitchen, in Mio. Mayfield's work was over for the season, and he was free to show us a warbler's nest in the morning. Van Tyne still had a couple of days' work left, watching birds he had marked with colored bands. Before 4:30 the next morning, while a wood pewee sang its low, soft "twilight song" outside the cabin, we breakfasted with the "bird doctors" on doughnuts and coffee, grapefruit slices and bread, canned pears and orange juice. Thus fortified with vitamins, we started the day.

A new nesting area had been discovered not long before by Verne Dockham, Conservation Officer for the region. It lay among small jack pines, a dozen miles east of Grayling. Three or four pairs of warblers occupied it. Each spring, it is the habit of the returning males to stake out their territories, ranging from a hundred yards to a quarter of a mile across. Immediate chase is given to any small bird that invades the area. The alertness of the males is advertised by their endlessly repeated, far-carrying songs. It is the ear that first detects the presence of a Kirtland's Warbler nesting site.

From mid-May to the last of June —the normal nesting season of the warblers—the song of the male is repeated with almost monotonous regularity. The first thing that surprised us about this song was its shortness. It lasts only about as long as it takes to say "Chattanooga choo-choo"—two seconds or less. The second thing was its loudness. Starting low, it progresses with an ascending "che-che-che," almost like a stammer, suddenly bursting out in a loud, ringing "wee-wee." Once, during the morning, I drove down the road to a slight rise a fifth of a mile away. In spite of the fact that the breeze was blowing in the wrong direction, I could hear perfectly a male singing in the top of a fifteen-foot jack pine.

In fact, when we were close to a singing warbler, the ringing final "wee-wee" was often so loud that it hurt our ears. The song of the Kirtland's Warbler has been described as resembling that of the House Wren and the Northern Water Thrush. It has a bubbling quality. The sound grows louder and faster as it progresses until the final notes come out in a sudden rush. The singing male has the appearance of being in the midst of a kind of spasm. It vibrates, jerks, bobs, seems to jump up and down with the violence of its effort. Its bill is lifted high, its lower mandible moving rapidly as though it were gobbling food. The song of one male seems to stimulate a reply from a neighboring warbler. The males sing when high in trees, low on branches, and even in flight. Several times we



▲ NOWHERE OUTSIDE the small shaded area shown on this map does the Kirtland's Warbler nest. It winters in the Bahamas

saw a male arrive at the nest with its bill crammed with small caterpillars. In spite of this impediment to song, it would pause on a branch near the nest, lift its head, and sing as loudly as ever.

The appearance of the Kirtland's Warbler is as arresting as its song. Conspicuous black streaks mark its bluish-gray back. Its breast is lemon-yellow with bold streakings along the sides and on the flanks. It is a large warbler, measuring five and three-fourths inches from bill to tail. The male has a distinctive black mask running back along the sides of the face. The female, lacking this mask, is clad in duller, grayer plumage. Both birds have the habit of jerking or wagging their tails. Even in silhouette and when the bird is silent, it can be distinguished from the Chipping Sparrow or other small birds by the characteristic jerking of its tail. The only other common warbler in the area that jerks its tail is the Prairie, easily distinguished from the Kirtland's by its reddish-brownish back.

Almost all day long, we sat only fifteen feet or so from the warbler's nest. Both birds were remarkably fearless. After only a short period of uneasiness, they came and went regularly. I set up my camera on a tripod in the open, no more than eight feet from the nest. In less than five minutes, the female was perching on the bellows. Once, when I was standing motionless beside the camera, the male actually dashed between the legs of the tripod in a rush to drive off a trespassing Chipping Sparrow. Individuals vary in shyness, but the Kirtland's Warbler is noted for its lack of fear. The second ornithologist to report a visit to the nesting area in Michigan, Edward Arnold, of Battle Creek, reported in *The Auk,* in 1904, that he found the female warblers so unafraid that they could be caught in the hands on the nest. One male, singing at the top of a jack pine, let me take a position directly under the tree, merely cocking his head to one side to look down at me. Even when I shook the tree, he flew hardly six feet away to the top of an adjoining pine. Unlike most warblers, shy and elusive, appearing and disappearing, the Kirtland's is a dominant personality—one of the outstanding birds of the pine barrens.

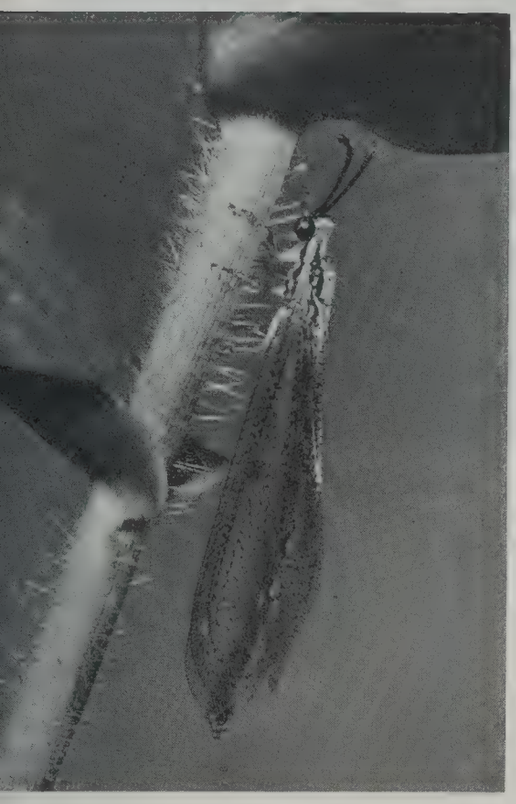
The nest, where we spent most of our time that day, was on the ground hidden among blueberries and sweet ferns and dry, wiry grass. The adult birds reached the nest through a kind of tunnel or bower of overarching grass. The nest, itself, was a little cup lined with fine grass, bark, and deer hair. It contained four fledglings in pinfeathers. They had hatched from white eggs speckled with brown. The incubation period for such eggs is about fourteen days. For ten days after hatching, the birds remain in the nest. During the early part of the nesting period, cold snaps are not uncommon. There is a record of frost for every month in the year in Oscoda County and often Van Tyne and Mayfield find their shoes white with rime when walking across the frost-covered pine barrens in early June. Under such conditions, the warblers seem to cease operations. If the nest is half-done, work is stopped; if it is completed, the female delays laying the eggs until warmer weather arrives.

The site of the nest is almost always the same: a little opening surrounded by young pines. Their low branches provide the required steps or perches close to the nest. Almost always the birds we watched

FIRE HAS KILLED this jack pine. If young growth succeeds it, the spot will be acceptable to the Kirtland's Warbler

➤ THE FEMALE is clad in less brilliant plumage and lacks the mask. These birds are remarkably fearless

ADULT ANT LION, an insect that forms part food of the nestling Kirtland's Warbler



hopped from branch to branch in approaching the nest. When the trees grow too large and the branches interlock and shelter the little glades that had been open when the trees were young, the warblers move to new nesting sites. Comparatively few enemies prey on the warblers in the pine barrens. Sharp-shinned hawks sometimes skim down to carry them off, and in a few instances, cowbirds remove the warbler eggs and substitute their own.

In feeding, the warblers appear to comb the lower branches of the pines, usually within three feet of the ground. Small caterpillars, varied with an occasional gauzy-winged adult ant lion, was staple fare on the day we watched the endless procession of meals being brought to the nest. Not infrequently, one of the birds would gobble down a caterpillar hastily, usually the first one encountered after feeding the fledglings. Each time it followed the same procedure. It cocked its head, snapped up the worm, gulped it down, and then wiped both sides of its bill on a twig rapidly as though whetting a knife—jerking and wagging its tail all the while. The tail wagging seems to increase at times when the warbler is excited.

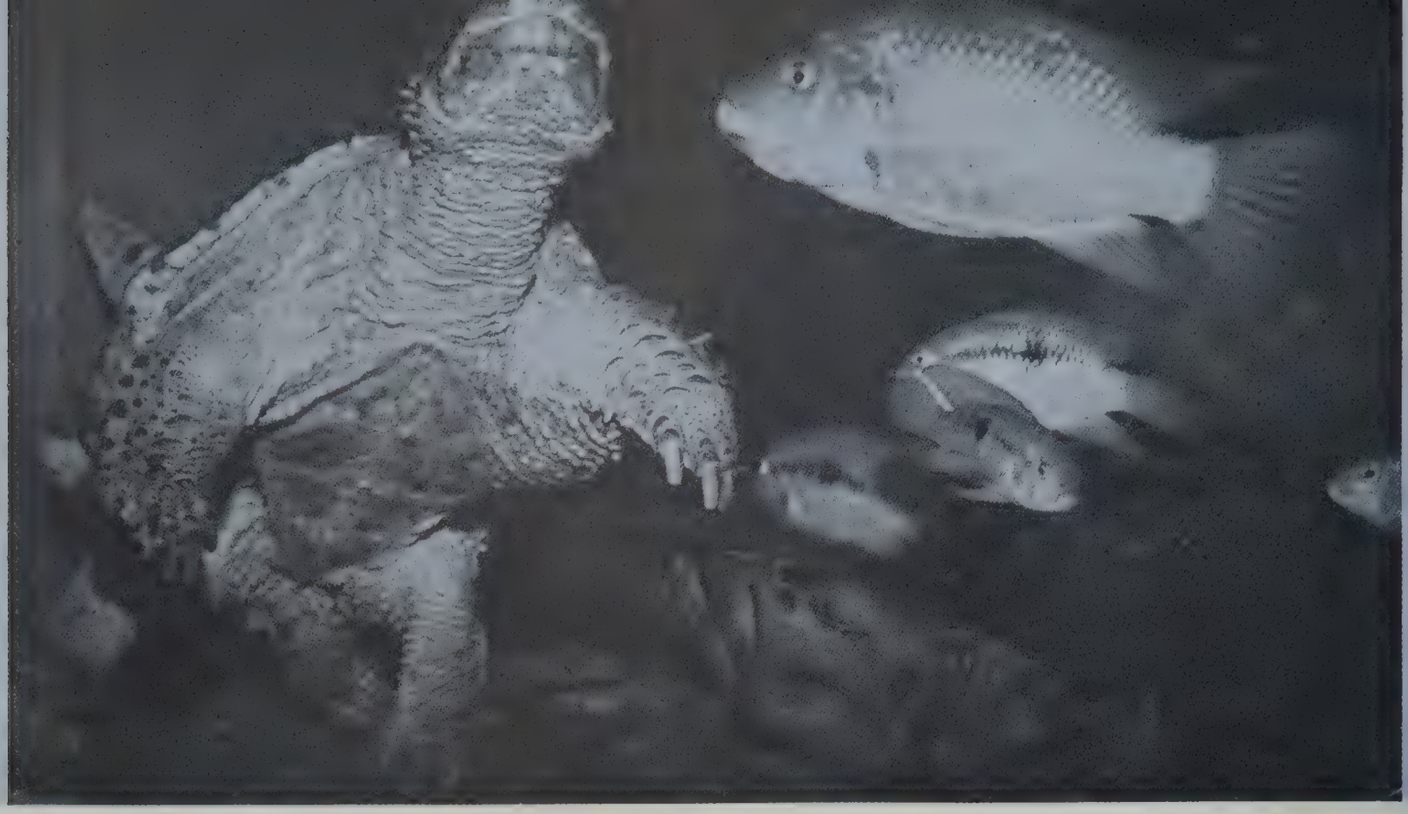
On one occasion, we saw a female flutter like a flycatcher to pick an adult ant lion from the air. Three or four times the male returned with the wings of one of these insects projecting like long moustaches from either side of its bill. Ants are everywhere in Oscoda County's sandy soil. So are the ant lions which, in their immature form, excavate conical pits in which to trap their ant victims.

One curious thing about the feeding habits of the Kirtland's Warbler is the fact that neither Van Tyne nor Mayfield has ever seen one of these birds drink water. Perhaps they obtain moisture from the heavy dews that are characteristic of the region. Or it may be that the larvae they consume provide sufficient fluid for their needs.

On each trip to and from the nest, the birds we observed most closely used the little tunnel of overarching grass. At the end of every visit, as the warbler emerged from this bower of grass, it gave a little fluttering bound, six or eight inches high, as it flew away. This upward bound and flutter was characteristic of the pair we watched.

The Kirtland's Warbler spends only about four months out of the year among the jack pines of its Michigan breeding grounds. The birds return from the south sometime between the tenth and the fifteenth of May. Males and females arrive together. By September, the warblers, old and new, are moving southward on their migration to their wintering grounds on the islands of the Bahamas. Snow comes early in the Michigan pine barrens. The winter is long. During these months, when deer and foxes and snowshoe rabbits are leaving their trails in the drifts, the small band of jack-pine warblers, having traveled south and out over the sea, are living in a land of plentiful food and sunshine.

The next day when, like birds migrating southward out of season, we headed away from the jack pine barrens and their rare warbler inhabitants, we remembered W. H. Hudson's delight on seeing the Dartford Warbler of England, the almost-vanished "furze fairy." Ever afterwards, when anyone mentioned having seen a rare species, Hudson used to say: "But *I* have seen the Dartford Warbler!" We felt the same about this colorful little songbird of the jack pines. *We* had seen the Kirtland's Warbler!



▲ THIS PONDEROUS inhabitant of our muddy ponds and rivers can bite the end off a broomstick, but he cannot dart quickly about in quest of the fish upon which he depends for food. He uses a built-in angling worm in his mouth to lure his prey within grasp

SNAPPERS— Underwater Fishermen

Unlike the small boy who has to dig for worms the day before he goes fishing, the giant alligator snapping turtle is equipped with his own wriggling bait

By WOODY WILLIAMS

Photos by the author, courtesy Steinhart Aquarium, California Academy of Sciences, San Francisco

A PUBLIC AQUARIUM is a different place when the last curious visitor has left. The halls are quiet and the light in the tanks dim. Many of the creatures react to the softened light by settling to the bottom to rest. Their show for the day is over.

There are certain creatures, however, that slyly become busy after dark. Take for example the giant alligator snapping turtle, *Macrochelys temminckii,* at the Steinhart Aquarium in San Francisco. He picks a corner of the tank, or a passageway in a rock, where other inhabitants of the tank are prone to rest, and then he begins to fish.

He opens his ugly jaws wide and remains motionless — except for a curious, wormlike structure in his lower jaw. It is close to his tongue but lighter in color. The two free ends of this organ are rapidly rotated, imitating the squirming movements of a worm or grub. Generally, the turtle sets this apparatus in motion when he is near a fish cornered in the tank bottom, where escape is restricted. His prey seems hypnotized; it remains motionless, as if frozen by fear. The turtle then edges a bit closer and, when within striking distance, lunges at the fish with jaws open. The snap when he claps them shut can be heard through the thick plate glass of the tank. Despite the confined quarters, the victim often escapes, but the scarred sides and torn fins of a number of the fish—large South American cichlids—indicate many narrow escapes. I have actually observed the turtle catch a fish six inches long, hold it between his jaws for a moment, and then gulp it down whole.

Raymond L. Ditmars, the well-known American herpetologist, was the first to report this curious device in the snapper's mouth. His observations, along with other scattered reports, seem to indicate that fish are lured near or into the snapper's mouth in an attempt to catch the "bait," which inside the gaping jaws looks like a worm in a small cave. There is no doubt that in nature the lure is effectively utilized for food capture, for the turtle is normally moss-covered and when motionless looks like nothing more than a submerged rock. In Steinhart's tank, however, fish were never observed actually to swim or dart toward the lure. Of course, constant association with the turtle may have modified their normal reactions. Having been attacked so many times, the fish have probably come to fear the snapper's gaping jaws and bulky body, which are not so well concealed as they would be in a muddy pond in the Mississippi Valley. Thus the turtle can hope to

satisfy his appetite only by backing a resting fish into a corner.

In the wild, the snapper's favorite haunts seem to be muddy areas varying in size from ponds to large rivers and bayous. Its range extends from northern Florida northward to Quincy, Illinois; along the Ohio to the Lower Wabash; and westward to San Antonio, Texas. The fossilized remains of this creature have been found in Pleistocene deposits on the Brazos River a short distance above Navasota, Texas.

Throughout its range the snapper's only nonparasitic enemy is man, who sometimes hunts it for food or kills it in the belief that it depletes the supply of waterfowl and game fishes. Its eggs are also occasionally eaten.

The snapper is the largest freshwater turtle in the United States, attaining a length of over 2 feet and a weight of over 200 pounds. It is famous for its tremendous strength. One specimen was reported by Ditmars to have easily severed three inches off the end of a broomstick, and he had seen snappers cut up fish so neatly that the pieces looked as clean as if sliced by a die. Clifford H. Pope, in his *Turtles of the United States and Canada*, mentions a snapper that carried, without concern, a 165-pound man on its back in Metropolis, Illinois.

Ditmars says that these turtles are shy when in captivity without cover, but the literature also indicates that once a snapper is aroused to anger, it will strike like a snake. Caution should therefore be observed in handling these creatures.

The snapper probably lives for many years. One specimen survived for 42 years in the Brighton Aquarium, and one for 47 years in the Philadelphia Zoological Garden. As the latter specimen was well grown when received, it is believed to have reached well over 50 years of age. The large male shown in the photographs, which is now on exhibit at the Steinhart Aquarium in San Francisco, may readily have reached this age.

When you observe these ponderous creatures rising to the surface for a gulp of air, or ambushing a fish with their curious lure, it is easy to believe not only that they are well equipped to attain a ripe old age but that they may have snapped their way through quite a chunk of history.

▲ RISING to the surface to breathe: an air-breathing animal that has invaded the underwater world to carry on one of the strangest fishing methods found in nature

▲ THE WHITISH, WORMLIKE ORGAN on the floor of the mouth has two free ends, which rotate rapidly like a squirming worm or grub. The fish remains motionless, as if hypnotized

◀ EDGING CLOSER, the turtle lunges at the fish with jaws wide open. The snap of the powerful jaws can be heard through the thick glass of the tank

▲ LIKE A FOREST of miniature trees, *Arcyria denudata* spreads its brick-colored "foliage" 1/16 of an inch above the surface on which it grows

Little Mike

Enter the mysterious realm where plant and animal are almost one, and you will witness one of the most astonishing transformations in Nature

By HUGH SPENCER

Photographs by the author

IN the middle world that lies between the plant and animal kingdoms there flourish several half-plant, half-animal organisms that bear characteristics of both groups. Most interesting among these are certain fungus-like creatures that are known by the not very prepossessing name of slime molds. In botanical terminology they are called Myxomycetes (pronounced MIX-o-my-SEET-eez).

The motile phase of this organism is called a plasmodium. It has the consistency of thin jelly and moves about freely, creeping through moist spaces in rotting wood or among dead and decaying leaves. It has no fixed form or shape but varies like a thundercloud, putting out feelers that billow out and expand as the rear end is withdrawn and absorbed. Unlike most living things, it has no cellular structure or specialized tissues of any kind. It glides along absorbing food (decaying vegetable matter, living bacteria, and fungal hyphae) from its environment.

Collecting and studying Myxomycetes can be a most entrancing hobby, and, although the number of persons who pursue this avocation is not great, those who have tried it have been amply entertained by the unique character and behavior of their pets.

In the life of a slime mold there are two conspicuous phases—plasmodium and sporangia. After weeks or months, sometimes years, of unfettered existence in moist, dark retreats, the plasmodium seeks a higher, drier location in which to transform from creeping jelly to stationary sporangia. The multinucleate protoplasm changes into one or more complex structures having many characteristics of fungi.

The nature photographer, in pursuit of new material for his negative files, may spend many hours in the field and return empty-handed and weary at the end of the day. Then, in his own dooryard, or while sitting quietly in his studio in the evening, something he has long sought in vain turns up right at hand. Such was the case with Little Mike.

A tobacco jar on my worktable, which had previously served as a terrarium for some small frogs, was the scene of my first encounter with the motile Myxomycete. Sphagnum moss and some dead leaves filled the bottom of the jar. One evening out of this material, slowly pulsing up the side of the glass, arose the fanlike network of Little Mike's advancing plasmodium. Fascinated, I watched while the pattern moved and changed like cumulus clouds rolling up the sky on a summer afternoon. Slime mold! What an utterly shameful and inappropriate name for one of Nature's most amazing and beautiful forms of life.

Older zoological literature places the Myxomycetes among the Protozoa and thus in the *animal* kingdom. Some have called them Mycetozoa, or "fungus animals." But leading modern authorities regard them as fungi, which are part of the *plant* world. Thus our mystery organism, along with several groups of flagellates, enjoy the curious distinction of having been placed in both of the primary divisions of life.

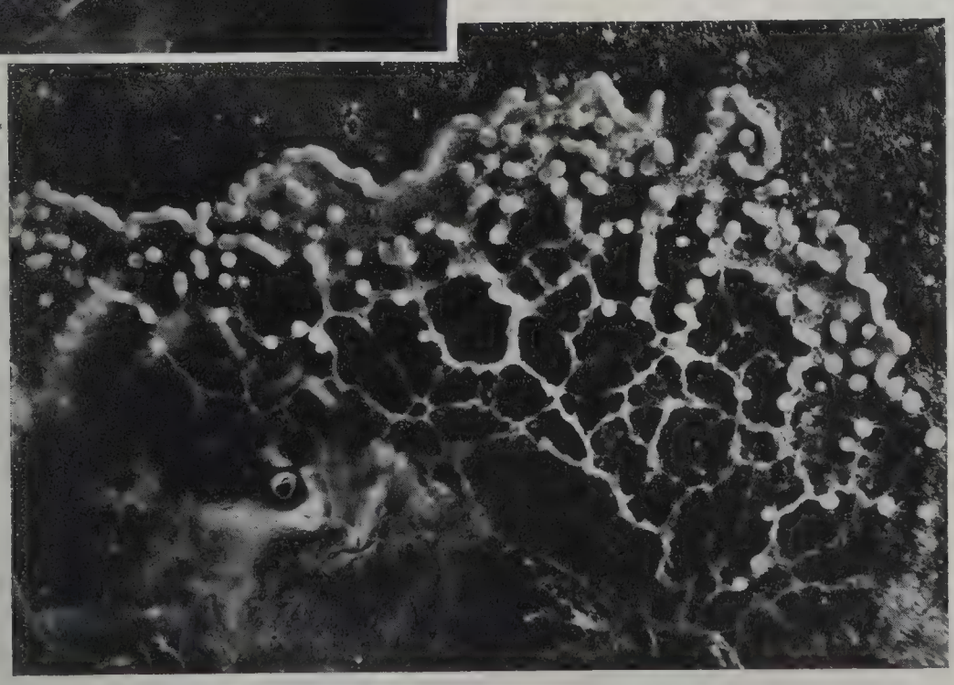
Fusing, or confusing, Myxo with Myceto, we came up with "Mike," and consequently Little Mike is the nickname by which the specimen in the tobacco jar will henceforth be designated.

Little Mike was a translucent, milky-white tracery, with the leading portion forming a fan of radiating veins. These veins, flattened against the glass to the size of a quarter-dollar, were trailed by a mesh of lesser veins. Below this a second mass of smaller size pushed up out of the muck. The rate of progression was about a quarter of an inch an hour. On several successive evenings I watched Little Mike advance and retreat, expand and contract, exploring the surface of the jar and, apparently, always striving for some higher, better life than that in the wet soil.

Animated protoplasm without nerves, without brain, without muscles, heart, or respiratory organs, yet capable of controlled and seemingly purposeful movement, of response to light, heat, and moisture—surely such a thing is worth anyone's attention. Think of it: a thing able to select digestable material; fluid enough so that a specimen has been known to pass through a mass of wet cotton wool and re-form on the other side, yet firm enough to

retain character and unity under normal conditions; and, further, an organism able to change its structure into the diversified tissues of reproductive sporangia.

Fructification is the ultimate goal of all slime molds, as it is of higher plants and animals. So far, our creature has behaved like an animal: it moved like an animal, its feeding habits were animal-like, and its behavior was like that of a giant amoeba. I did not witness the transition of Little Mike from motile plasmodium to stationary sporangia, as that event took place dur-

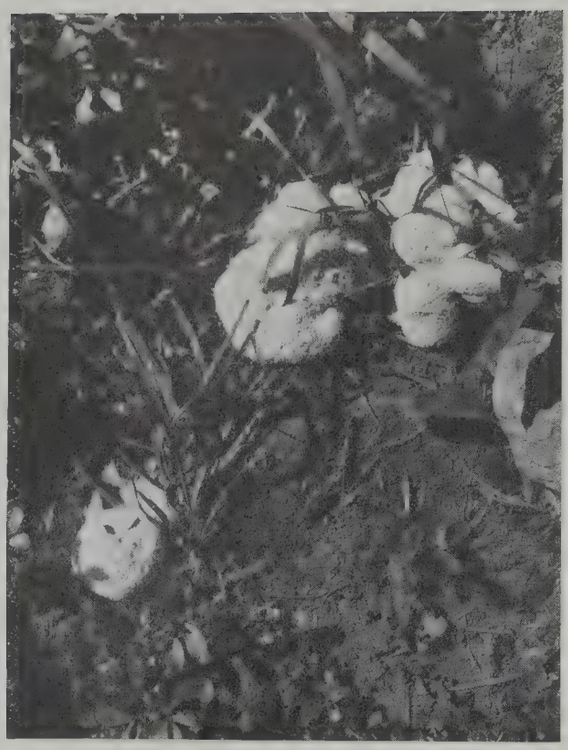


▲ CAPABLE of controlled and seemingly purposeful motion and of response to light, heat, and moisture, the jelly-like plasmodium surges forward at the rate of an inch every three or four hours. A specimen has been known to pass through a mass of wet cotton and re-form on the other side

OVERNIGHT the simple but animate plasmodium (*left*) became a cluster of inanimate but complex sporangia with plantlike characteristics (*below*)

ing the hours of night or early morning. Overnight the creeping fungus had reached the top of the jar and had broken up into a multitude of minute, spherical sporangia, smaller than pinheads and tangled in a stain of dried and hardened tissue. All that remained of Little Mike was now a cluster of structures bearing no resemblance to the original organism. Without seeing the metamorphosis, or at least having previous knowledge of the behavior, one would have difficulty recognizing these motionless bodies as the alter ego of the erstwhile roving plasmodium. The process by which this rudimentary film of protoplasm becomes a complex structure of differentiated tissues is one of the most astonishing phenomena of nature.

The sporangia of different species

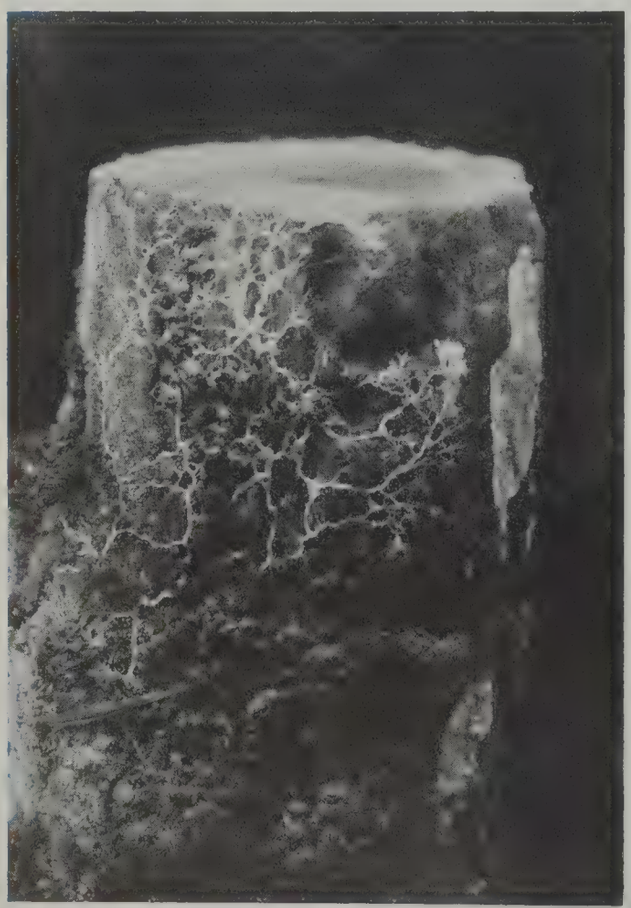


▲ CHANGE IN TWELVE HOURS. On a July evening, this slime mold was found spreading over the ground near a compost heap in the garden. The following morning these biscuit-shaped masses had appeared, flattened against the ground. The largest were about four inches across

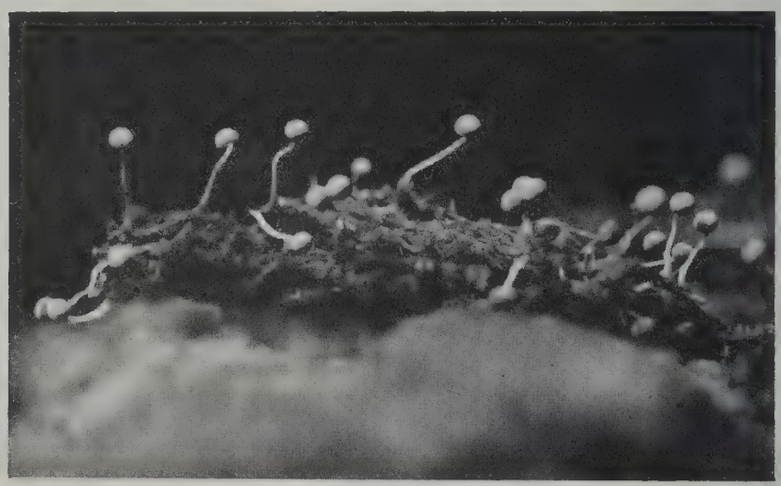
vary greatly in size, shape, and color. Little Mike was a *Physarum* with minute globular sporangia. *Stemonitis* produces clusters of slender plumes less than a quarter of an inch in length. Under a magnifying glass a group of *Arcyria denudata* looks like a forest of miniature trees with brick-red foliage. The largest species is *Fuligo,* which produces sporangia as large as a man's hand and about an inch thick. Although these sporangia differ greatly in appearance, their function is the same in every instance. All of them produce minute spores, which are easily scattered by the wind and will germinate readily wherever they find suitable moist conditions.

The ensuing stages between spore and plasmodium can be observed only with the aid of a microscope. The naked, amoeboid protoplast that escapes from the spore

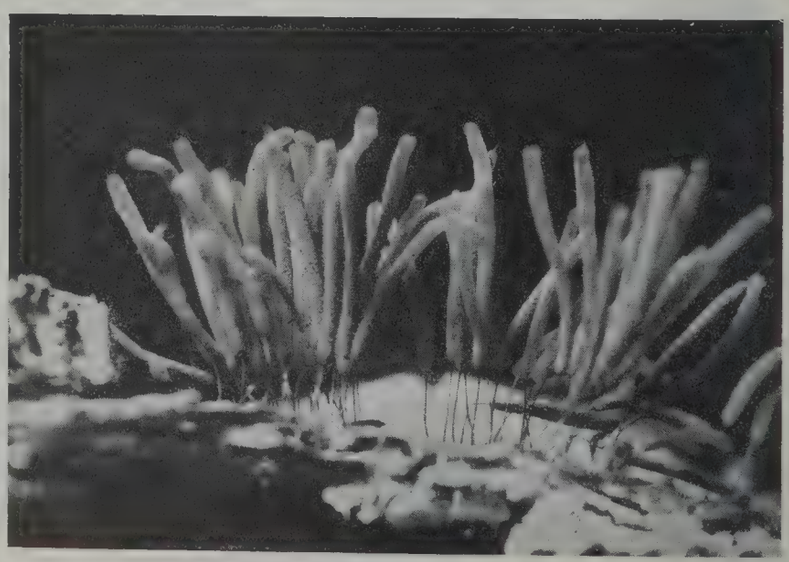
Continued on page 190



▲ A YELLOW PLASMODIUM on an old stump. The extended rays and branches would aggregate many feet in length



▲ THE TINY GLOBULAR SPORANGIA of *Physarum* on their slender stalks



➤ DAINTY PLUMES of *Stemonitis,* commonly found near oak trees. These Lilliputian "cat-tails" stand about $\frac{3}{16}$ of an inch in height

Photo by U. S. Forest Service

▲ EVERGREEN FORESTS and myriads of lakes characterize the Quetico-Superior wilderness

CONSERVATION *Victories*

By RICHARD H. POUGH

Chairman, Department of Conservation
American Museum of Natural History

IN a field in which defeats have all too often been the order of the day in recent years, it is heartening to have two great conservation victories to report.

Under the terms of a recently issued history-making executive order, an air-space reservation has been established over the million-acre Quetico-Superior wilderness area of northern Minnesota. On January 1, 1952, all flights into the area or over it at less than 2000 feet must cease. This should put an end to the resorts that were beginning to grow up deep inside the roadless area and were so out of keeping with its whole character. It should also expedite the task of buying out the few privately owned tracts that still lie scattered through the publicly held national forest land.

This air closure removes one more obstacle to the final creation of a great international peace memorial forest on both sides of the United States-Canadian border. It will be a forest open to all who seek solitude and are willing to find it via the canoe or on foot. The final establishment of such an area will make certain the preservation for all time of at least one area in the United States remote and wild enough for the survival of a small nucleus of timber wolves, which disappear everywhere as civilization moves in. Here there will be no reason to

Ewing Galloway photo

◀ SNAKE RIVER and the Teton Mountain Range

challenge nature's law that the race belongs to the swift and that the plant eater lives but to feed the meat eater.

With the deeding of some 300,000 acres of land in Jackson Hole to the National Park Service by the Rockefeller interests, the long-drawn-out controversy over the Jackson Hole National Monument comes to a virtual close, and the preservation of the primitive character of this glorious valley is assured. A few problems remain to be solved, but they can now be worked out on a calm basis of fact instead of in the heat of political battle. The most important problem concerns the elk population that summers in Yellowstone Park and the adjacent national parks. Blocked now for many years from access to their ancestral wintering grounds in the Red Desert, these elk must be prevented from increasing to levels that can only result in wholesale starvation and devastating damage to the limited wintering range still available. In the absence of predators, this means that there must be sufficient sport hunting or annual butchering by park rangers to hold the population at the level where it can be supported in vigorous health and where it will not overbrowse and destroy its food supply.

For the first victory, every American conservationist who did not leave it to the other fellow but made his own voice felt can take credit. This is in part true also in the second case; but let us not forget that there would have been little to battle for if a public-spirited American family — the Rockefellers — had not been willing to provide nearly one and a half million dollars to purchase the critically important Snake River bottomlands that years ago had been allowed to pass into private hands.

Unfortunately, many another conservation project having equally great public support—such as the attempt to save as a national park or wildlife refuge the last small section of undeveloped beach on the coast of New Jersey—languishes for lack of more Americans as public-spirited as the Rockefellers.

Woodlan

How startling—and sometimes baffling—are the ways in w

"My woodland throne,
I must confess,
Was won by means
You may not guess."

A branchlike root
Above the ground—
Did the rock rise up
Or the tree slip down

londers

tree grows with all odds against it!

By WILLIAM M. HARLOW
New York State College of Forestry

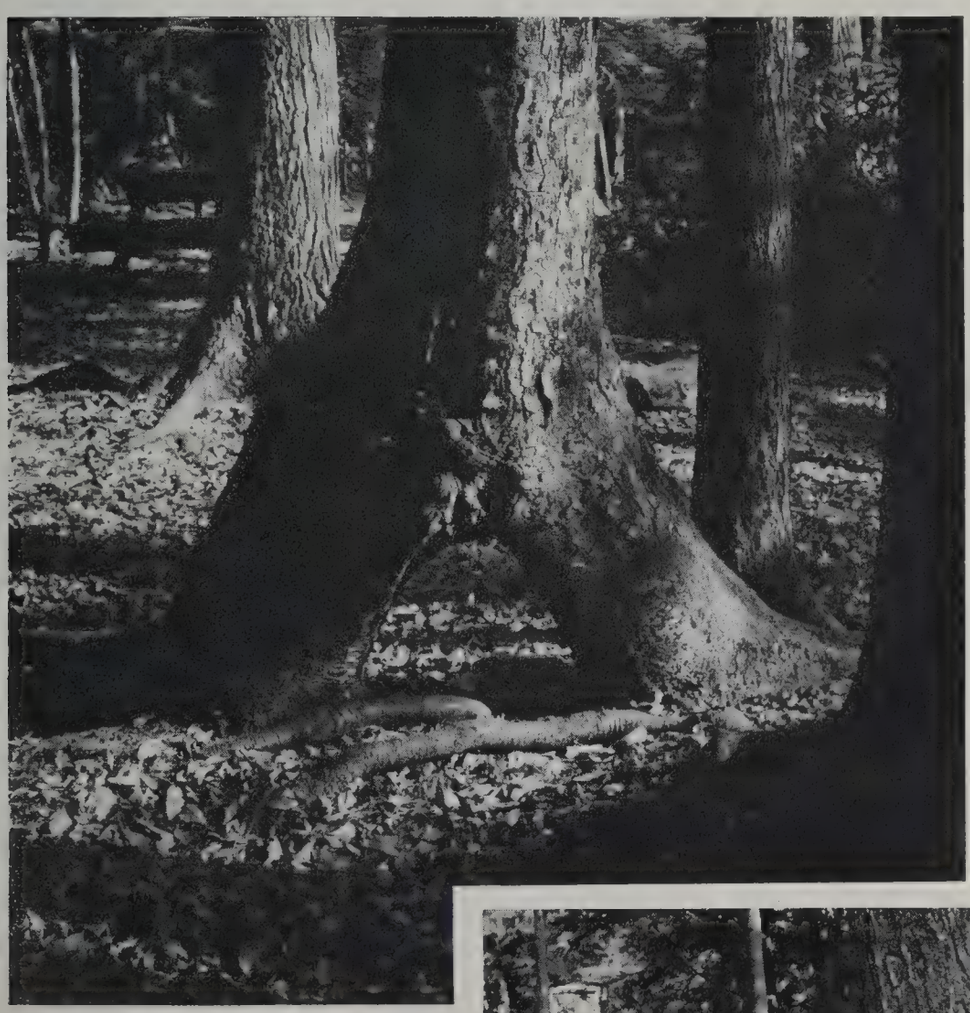
Photographs by
HELEN FAYE

ONE of the most interesting things to observe in the woods is the manner in which a young seedling tree makes the best of a seemingly hopeless or at least difficult situation and manages somehow to live and grow and even to prosper. In these days of Existentialism and other hopeless philosophies, it does one good to walk along a woodland trail and to see trees like the ones pictured on this page. They were all photographed in Cook Forest Park, Pennsylvania.

The first photograph shows a fairly common situation in which such trees as black birch, yellow birch, and hemlock manage to extend their roots along the surface of a rock upon which the seed fell, and eventually to reach the ground below.

The tree shown at lower left is not so easily explained. There seem to be two possible answers. The first is that it started on top of a small stump which was close to the rock; the stump finally rotted away, but not until a root had grown laterally over to the boulder. The other possibility is that the young tree grew in some moss at the edge of the rock and slowly shifted to its present position. However, it is quite possible that neither of these suggestions furnishes the correct explanation!

The trees in the two other photographs very evidently began life on an old, perhaps rotting log which has long since disappeared.



"From front and rear
I ape a dancer,
But why I'm arched
Is yours to answer."

Did these roots
Deny their birth
By springing upward
From the earth?

YOUR NEW BOOKS

Death of a Science in Russia • New Zealand
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DEATH OF A SCIENCE IN RUSSIA

- - - - - Edited by Conway Zirkle

University of Pennsylvania Press
$3.75, 319 pp.

THIS account of the perversion of the science of heredity in the Soviet Union is one of the most terrifying books ever written. Bombs kill only bodies. The killing of knowledge and of free enquiry is a far surer way to stop human progress and to enslave mankind. Ten or fifteen years ago it seemed incredible that such things could happen in a civilized country and in one that had, regardless of possible other faults, tended to value and to support true scientific research. Here is the damning record of intellectual murder and a display of the means employed, both subtle and brutal.

Apologists have represented the outcome as a result of open and democratic scientific discussion, and anti-communists have cited it as a simple example of police-state methods and dictatorial thought control. The detailed evidence shows that neither view adequately represents the process or the danger. A parody of scientific discussion was used to suppress rather than to seek the truth, the exact opposite of the procedure travestied. This was only one of the many methods used in a long struggle. The struggle was already lost before it reached the last stage of overt political control and open reprisals against those who failed to run to cover or to recant, publicly shaming the values for which they had lived.

Dr. Zirkle has supplied such background as is necessary for the nongeneticist to appreciate the issues and to follow the sequence of events. The bulk of his book consists of authoritative documents, mainly reports from *Pravda* plus some other statements by informed persons, such as the eminent geneticist Muller, who had realistically approved earlier Soviet accomplishments in science. The evidence is plain. The implications are so extensive, even outside the field of science, and so menacing to freedom of thought and of institutions that this book should be required reading for anyone honestly interested in human welfare.

The only serious editorial imperfection is the lack of a list of *dramatis personae* or an index.

G. G. SIMPSON

AN INTRODUCTION TO BIRDS

- - - - - - - - - - by John Kieran

Garden City Pub. Co.
$2.00, 77 pp., 99 illusts.

TO ONE who married the American Ornithologists Union 38 years ago, John Kieran's *An Introduction to Birds* comes as a blessing 39 years overdue.

The amateur is too often plunged into ornithology before having any chance to learn the abc's of birds themselves. The professional ornithologist is so far along in the disease that he rarely clicks with the beginner. The former knows so much that the layman regards him with awe. Writers try to emulate him, tucking in scientific names and descriptions.

Along comes everybody's John Kieran, with his courage and his humor, without self-consciousness among his ornithological pals. He tells, in clear language and with scholarly simplicity, how to know the birds.

"The first rule to follow if you want to know the birds is: Look at them!" says Mr. Kieran. One can add a second rule: Get Kieran's book.

There are 99 colored portraits of our whole country's common birds, with their approximate lengths in inches below their common names. Clear descriptions tell in what kind of setting each bird may be found—whether woods, fields, seashore, gardens. Songs are beautifully described, with particular appreciation for that of the hermit thrush: "lovely, liquid, dreamy, ethereal."

Kieran's style matches the charm of the birds he is sharing:

"The simple facts about Hummingbirds are like the birds themselves, almost unbelievable," and, "The flashing Tree Swallow that sweeps in chattering flight over our summer meadows. . . ." On every page there are such phrases. Poetry and accuracy are not always twins, but Mr. Kieran is a trained observer with knowledge of his subject as background for his sensitive appreciation and his gift for its expression.

The reproductions in color of Don Eckelberry's paintings are beautifully done. The book is both distinguished and delightful to own or to give away. The price is also delightful in these days of high-priced books.

GRACE E. BARSTOW MURPHY

PREHISTORIC SOUTHWESTERNERS FROM BASKETMAKER TO PUEBLO

- - - - by Charles Avery Amsden

Southwest Museum, Los Angeles
Paper—$3.50, cloth—$4.25
163 pp., 2 maps, 39 plates, 46 figs.

THE core of this publication is a comprehensive account of a once widely ranging, partly semisedentary people whose relics, dating from the first five or six centuries of our era, have been especially well preserved in the arid "Four Corner" region of the Southwest. They were called Basketmakers by their earliest discoverers in Utah, about 1890, simply to distinguish them from their Pueblo Indian neighbors who were expert potters. Their collected remains, both cultural and somatic, held a place of special importance for all regional archaeologists until traces of the much earlier and even more widely disseminated Folsom culture came to light in 1927. This temporarily dampened interest in the Basketmakers who, however, still retain the unique position of affording us our best American evidences of the gradual transition from the hunting to the agricultural mode of life.

Our author prefaces his subject with a prologue on the first peopling of America. He next devotes a chapter to a brief but glowing description of the Southwest, to its partial conquest and colonization, from 1540 onward, by the Spaniards, and

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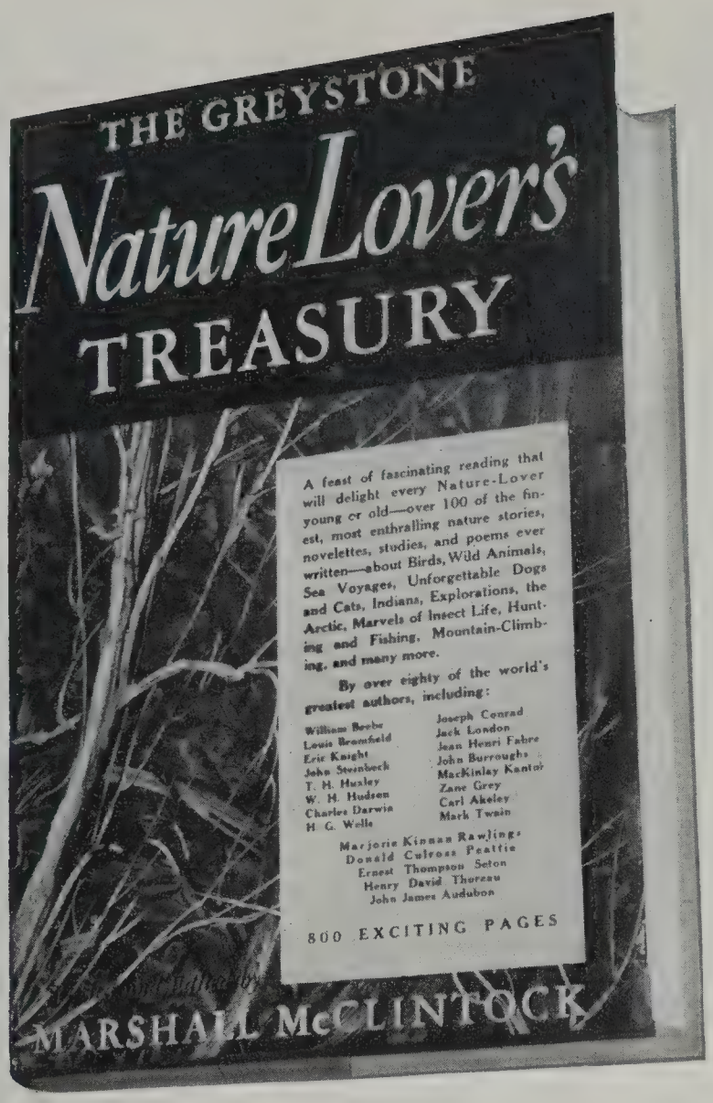
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to its more and more systematic archaeological investigation, mostly by Americans, from 1846 to the present day. Another chapter is added giving an intelligible explanation of the supplementary study of local tree rings which, applied to the timbers of both the inhabited and the long-abandoned Indian dwellings, has resulted in an absolute chronology for the region.

Six chapters of this book are devoted to detailed description and illustration of the principal traits of Basketmaker culture. These exhibit marked skill and taste in the manipulation of stone, shell, bone, wood, hide, hair, and clay, resulting in about 200 specific types of contrivances, answering to various requirements of the maker's activities. Among the features treated are dwellings and storage caches, articles of dress, personal adornments, ceremonial objects, human and animal paintings on suitable rock exposures, tools, weapons, household utensils, hunting gear; cultivated maize, squashes, and beans; domesticated dog and turkey; and, finally, the ceremonial disposal of the dead. This abbreviated inventory of more or less diagnostic traits did not, of course, originate all at once but was the result of improvements and additions ranging over more than half a millennium. The "improvements" may be ascribed to native ingenuity, but the "additions" were doubtless for the most part borrowed from neighboring tribes. This borrowing appears to have proved fatal, for in the end the culture lost its identity. The Basketmakers became Pueblos.

Mr. Amsden, now passed away, may not have left his aptly phrased and often illuminating treatment in its intended final form, but his colleagues and friends have checked it and supplied helpful and attractive illustrations, as well as a useful bibliography, and Dr. A. V. Kidder has added an appreciative Introduction.

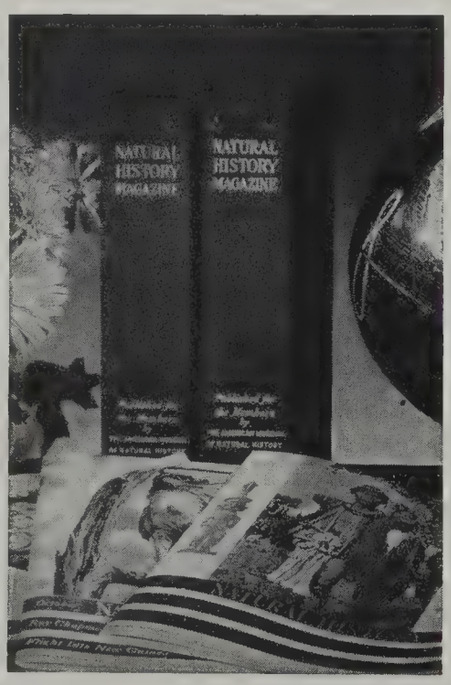
N. C. NELSON

FREDERICK CATHERWOOD, Archt

- by Victor Wolfgang von Hagen
Introduction by Aldous Huxley

Oxford University Press, $5.00
177 pp., 38 plates

IN the author's words, this biography of the nineteenth century architect, artist, and pioneer archaeologist is "an attempt to raise Frederick Catherwood out of the alluvium of the 'Stream of Time,' to cover him with flesh, and give him life." If one judges the book narrowly, and merely as an attempt to recreate a personality, Mr. von Hagen's effort does not quite succeed, but through



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no fault of his own. So completely has Catherwood been obliterated by time that no such recreation will ever be possible. Although he was an intimate of Keats, Shelley, Severn, Prescott, and Stephens, no journalist recorded his exploits and no artist painted his likeness. Indeed, the author was obliged to construct Catherwood's bare life history from bits and pieces drawn from Copenhagen, Cairo, London, and British Guiana.

Yet even the bald facts of Catherwood's incredible life are absorbing and worthy of record. Although he is justly famous for his magnificent drawings of the Maya ruins of Mexico and Central America, few are aware that Catherwood had also made firsthand studies of the ancient monuments of Italy, Greece, and the Near East. In addition, he was a pioneer Egyptologist of outstanding importance. If not actually the rediscoverer of Maya civilization, Catherwood and his colleague, John Lloyd Stephens, established its existence beyond all doubt and brought it to the attention of both scholars and the public. Between trips of archaeological exploration, Catherwood managed to practice his profession as architect in New York and elsewhere, to build the first railway on the South American continent (in British Guiana), and to participate in the California gold rush of 1849.

Mr. von Hagen has himself undertaken an "archaeological investigation" in assembling the facts of Catherwood's career from diverse and inaccessible sources. The book is a handsome contribution, and the numerous reproductions of Catherwood's drawings, and of lithographs and engravings based on them, are uniformly excellent.

HARRY TSCHOPIK, JR.

AUDUBON'S BIRDS OF AMERICA

- - - - Introduction and captions by Ludlow Griscom

The Macmillan Co., $2.95
320 pp., 288 colored plates

APPARENTLY encouraged by the success of their earlier royal octavo edition of Audubon's paintings of the birds of America, Macmillan has brought out this "popular edition." It contains some 288 of Audubon's plates, each reduced to a size of about four by five inches. The color reproduction in this volume, it must be admitted at once, is about the worst imaginable. Plain black and white would have been better. The blues are particularly obnoxious, and all sorts of birds—fox sparrows, mockingbirds, Connecticut warblers—are tinted with bright blue! The other colors are usually too dull; the flaming crest of the ivory-billed woodpecker,

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Birds of America

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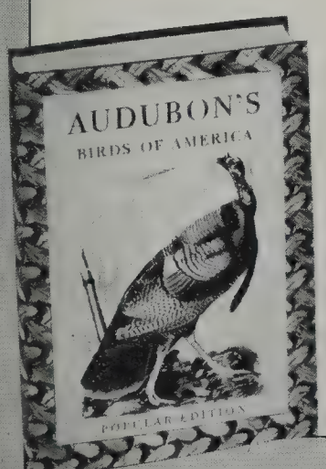

LUDLOW GRISCOM, Chairman of the Board of the National Audubon Society, has written a splendid, new Introduction, as well as the concise descriptive text accompanying each of the 288 magnificent plates.

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—JOTHAM JOHNSON, *N. Y. Times Book Review*

Frederick Catherwood Archt

By

VICTOR WOLFGANG VON HAGEN

Introduction by Aldous Huxley

■ Here, reconstructed from all the known original material, is the amazing life-story of the archaeologist-explorer and student of natural history whose discoveries in Mayan culture and superb lithographs of Central American antiquities alone entitle him to lasting fame.

■ Catherwood was a friend of the great scientists of his day in Europe and America. He was an authority on the civilizations of Egypt, Greece and Arabia. His exciting, checkered career has been re-created by an author who is himself an archaeologist, explorer and authority on natural history.

■ Besides its adventurous and revealing story the book also reproduces, for the first time since its original publication, the complete series of Catherwood's great lithographs "Views of Ancient Monuments."

■ "A most surprising story and very delightful to read . . . The reproductions of his beautiful drawings are exceptionally fine." — VAN WYCK BROOKS

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for example, is here a sickly brown. Of course, among 288 plates one finds some that are passable.

Ludlow Griscom has written a brief caption for each plate, giving the range, habitat, and status of the bird depicted. Since this information is available in so many other books, would it not have been better to quote a sentence or two from Audubon's own vivid "ornithological biographies"? In his general introduction Griscom makes it clear that the exaggerated and even grotesque attitudes of many of Audubon's birds were a symbol of his revolt against the stylized and unfeeling methods of portraying nature then in vogue.

This volume appeared shortly after two others in which a much smaller number of Audubon's paintings are much better reproduced. Comparison leaves no doubt that in things of this sort, quality is preferable to quantity.

DEAN AMADON

THE INVASION OF NEW ZEALAND BY PEOPLE, PLANTS AND ANIMALS: THE SOUTH ISLAND

- - - - - - by Andrew Hill Clark

Rutgers University Press, $6.00
465 pp., 81 illusts.

HERE is an admirable and detailed account of the relation between man and environment in the world's most isolated and most rapidly made-over land. New Zealand is the newest abode of human beings, whether we refer to the Polynesian aborigines who first arrived about a thousand years ago or to Europeans who began to settle close to the opening of the nineteenth century. The earliest comers were exploiters in search of whale oil, fur-seal skins, native "flax," and timber.

Immigrants seeking permanent homes arrived in the South Island mostly after 1840. They represented, in large part, deliberately organized efforts to transfer a cross section of British society, with all the contemporary mores, to the antipodean outpost of the Empire. Professor Clark, who has had critical experience in the field, shows clearly how developments in land use have departed widely from the plans of the founders. More and more, the inhabitants have come to depend upon their own experience and initiative in devising the pastoral and agricultural practices upon which their economy depends. Despite the British heritage and the nostalgic introduction of countless plants and animals from "home," the very landscape in the densely occupied parts of the island now smacks more of California than of Britain. The universal shelter belts and clumps of Monterey cypresses and Monterey pines—far more majestic than in their own hearthland—are a case in point.

This book deals, in terms as precise and quantitative as the data warrant, with the struggles, the successes, and the mistakes involved in the creation of a new, prevailingly rural culture. The "invasion" has had many tragic corollaries, because scores of alien organisms have become devastating, almost hopeless, pests. Coupled with reckless overuse of natural resources, they have led to land deterioration that is a challenge to the outstanding scientific competence and the finally aroused popular sentiment of the Dominion.

R. C. M.

LITTLE MIKE *Continued from page 182*

shell shows distinctly animal characteristics. It has a long tail, or flagellum, by means of which it may swim freely, or it may creep like an amoeba. These tiny protoplasts multiply rapidly by division, forming a multitude of "swarm cells." After a time, these cells unite in pairs to produce miniature plasmodia similar to the larger one already described. From time to time, as they meet others of their kind, they continue to unite, forming larger and larger units; or the single "miniature plasmodium" may develop by itself until the full-grown organism is produced.

The slime molds are of little economic importance, though one species is parasitic on cabbage roots and causes some loss to crops of this vegetable. They are interesting

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WILL REHDER, *Florist,* Wilmington, N.C.

chiefly as biological curiosities, as a sort of Dr. Jekyll and Mr. Hyde in Nature's underworld and, of course, for the attractive patterns formed by the plasmodia and the beauty and variety of the fruiting stages.

With the exception of *Fuligo*, the sporangia of Myxomycetes are so small that they easily escape the notice of all but the most observing persons. Would-be collectors should bear in mind that a single sporangium of *Arcyria*, *Physarum*, and many others is no larger than a capital letter in the type on this page, and that a plume of *Stemonitis* could easily be passed through a small "o." With this in mind, and after a study of the photographs accompanying this article, look for specimens attached to leaves, bits of bark and dead wood under old trees, or on rotting logs in the forest. The best time to find them is a day or two after a warm summer rain.

Plasmodia are rarely seen in the open. Slime mold enthusiasts usually obtain specimens by gathering bits of decaying wood, dead leaves, and forest litter. These are placed in covered glass vessels and kept moist and warm. Temperatures of 67 to 72 degrees F. are considered best. White blotting paper or pieces of paper towel may be placed under the material to facilitate observation. Then follows a period of watchful waiting, and hoping. Sooner or later a plasmodium may appear, spreading thin feelers out on the paper or onto the glass. It may be white, like Little Mike, or it may be yellow, green, tan, brown, orange, or even black. Whatever color, it brings elation to the slime-mold fan.

Plasmodia, as pets, require little in the way of care or attention. The principal requisite is moisture. Some collectors supplement the supply of natural food by sprinkling a small quantity of oatmeal flour into the enclosure once or twice a week. Under certain conditions, plasmodia may attain a ripe old age before changing to sporangia. One collector has a record of a specimen in captivity for nine years! A Myxomycetoid zoo can be fun.

Continued from page 155

and are interested only in telling the truth, no matter how amazing it may be. There are delightful drawings and wonderful photographs that aid greatly in the reader's enjoyment and understanding of the text. In the course of time, a regular reader of NATURAL HISTORY Magazine is bound to obtain a liberal education in the natural sciences with no feeling of pain. It widens our horizon and adds much to our enjoyment of life to know these things. Knowledge of one thing in Nature leads to another, and the effect is cumulative; the more we learn, the greater becomes the desire to carry further our knowledge of Nature, the world in which we live, and the Universe around us. Walled in as we are now by great cities, monstrous housing projects, specialized careers, and man-made gadgets and contraptions, more than ever we need to realize our true place in the sun and our proper relation to the stars in their courses.

Of all men, I think the naturalist is the one who can roam the farthest, get most out of life, meet friends wherever he goes, and, in the words of Thoreau, let the night find him everywhere at home.

L E T T E R S

Stag at Eve

SIRS:

This photograph, which was taken near here in the late afternoon, reminds me of the first line of Scott's "Lady of the Lake": "The stag at eve had drunk his fill." So that is what I call it, and I hope readers of NATURAL HISTORY will like it.

MRS. THASE DANIEL.

Norphlet, Ark.

It's a Nutcracker

SIRS:

On page 98 of your March issue is a photograph of a bird that is identified as a Canada Jay in the letter accompanying it. It looks more like a Clark's Nutcracker to me, judging from the white patch in the wing and the lack of a black nape, though it *might* be an immature bird. The bill also looks as if it could not be that of

a jay. Could you inform me regarding the picture? Incidentally, it is a fine photograph, regardless of the species, and yours is a fine magazine. I congratulate you on it.

PETER W. CASTLE.

Putney, Vt.

Mr. Castle is absolutely right, and we are serving a sentence of six months at hard nutcracking. —ED.

SIRS:

NATURAL HISTORY Magazine seems to grow more interesting each year. The article on the New Zealand Kiwi was read at our Stamp Club meeting the evening that our topic was "Birds on Stamps," and everyone found it interesting and amusing. My copy of the Magazine eventually goes to the local TB Sanatorium, where it is read to pieces, from all accounts. Everyone exclaims over the beautiful covers.

IDA M. LUTHER.

Norwich, Conn.

SIRS:

Among the innumerable letters that you receive, will you accept a modest tribute from me. I have under my eyes the whole collection of NATURAL HISTORY for 1949, and I must say that it is a veritable enchantment. With its harmony of colors and its scientific text, NATURAL HISTORY Magazine is a pure marvel which, in this painful era, puts a charming bit of poetry into our otherwise disillusioned hearts.

ALPHONES O. RENAUD,
Trumpeter in Jazz,
Composer of Music

Bordeaux, France

SIRS:

Just received our copy of NATURAL HISTORY Magazine for March, 1950. It is one of the finest issues I have ever seen, and I have all the copies since 1922. Every article in this month's issue has a very special appeal to me . . .

I am enclosing my check in the amount of fifty cents for which kindly send me another copy of this issue of NATURAL HISTORY.

You are to be congratulated for issuing such a wonderful magazine. Long may it be published under your editorship.

E. B. POWERS.

San Diego, Calif.

SIRS:

One or more red-tailed hawks could recently be seen spread-eagled on fences in three different but adjacent counties in California. In each case, the farmer retorted "chick hawk." So here are three startling examples of biological illiteracy, as will be seen by the last four words below.

In one of the above counties the writer had a bottomland ranch. Some 40 years ago, neighborhood farmers held a "hawk-and-owl shoot." They very systematically cleaned out both birds over a considerable area. Next year, the very prolific ground squirrels, being free from predator interference, raised numerous young.

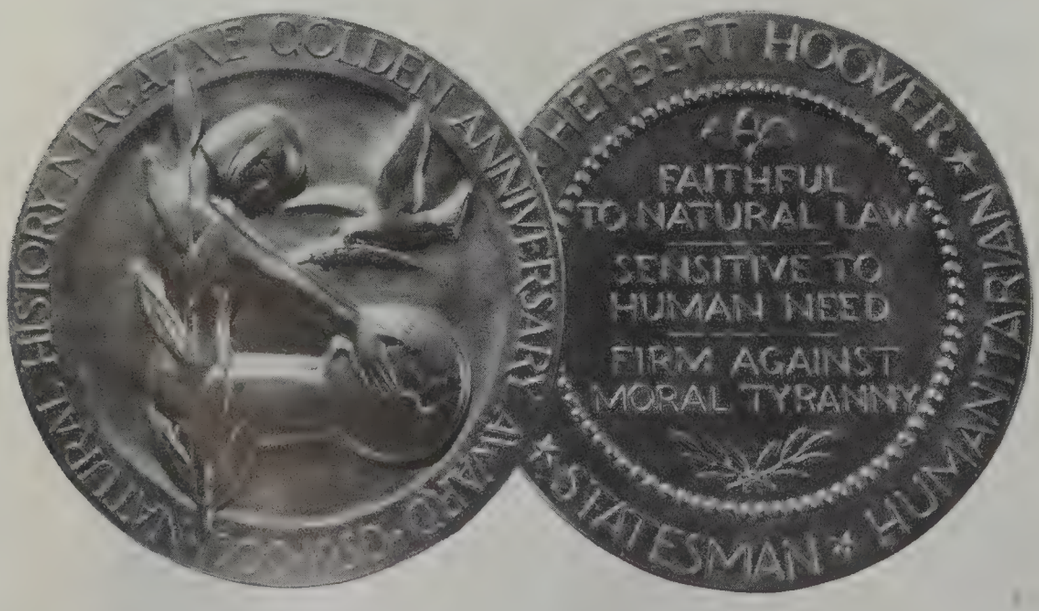
That winter came one of a lifetime's copious floods. The levee, during the summer, had been honeycombed with squirrel burrows. It crevassed under flood pressure, and sand was deposited over much of the writer's land. It was quartz sand from the tailings of gold mines upcountry. The ranch thus became a partial desert. Quartz sand does not rot, so soil-making proceeds painfully slowly. Now, after 40 years, we are starting to harvest the first beginnings of crops.

California scientists made a study of this hawk's food habits and analyzed 2,094 ejected food pellets. These showed 1,049 ground squirrels, 794 gophers, 322 rabbits, 14 jays, 70 rattlesnakes, 776 other reptiles. "NO POULTRY WAS FOUND."

C. M. GOETHE.

Sacramento, Calif.

★ *Medal awarded to Herbert Hoover by Natural History Magazine on its 50th Anniversary* ★



★ Designed by Paula Hutchison; sculptured by Joseph Renier ★

"Reservations" for Interplanetary Trips

Each visitor to the Planetarium's new production, "Conquest of Space," will be given opportunity to make a reservation for one of the first actual rocket ship passenger flights. The applications, issued at a simulated interplanetary terminal reservation desk, will be kept in the Planetarium's archives and will be turned over to the first organized passenger service to the moon, Mars, Jupiter, and Saturn. In the Planetarium production, visitors will have a thrilling "preview" of the sort of inspection tour of the solar system that science may make possible in the not-too-distant future; and the original paintings by Chesley Bonestell for Willy Ley's recent book, *Conquest of Space*, will be on display during the run of the production.

Special Jewelry Display

An unusual exhibit entitled "Silver and Gold with Stones" will display the artistry of a young designer, Yonny Segel, in the Morgan Hall of the American Museum until May 10. Mr. Segel explores the use of uncut stones and emphasizes the design principles that are currently applied in painting, sculpture, and architecture. His sculpture has been exhibited in various museums and galleries, including the Metropolitan Museum of Art and the New School for Social Research. He is now teaching jewelry and plastics to severely disabled veterans at an outpatient clinic of the Veterans Administration and is studying for his doctorate in Education at New York University.

MAY 5 1950

May 1950

NATURAL HISTORY

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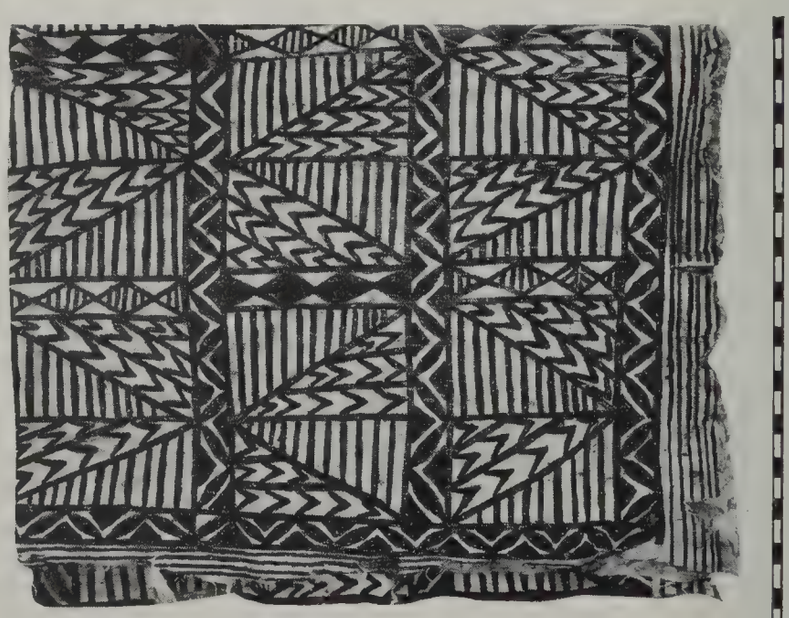
TAPA CLOTHS

63" x 63" *$8.50 each* *postage 15¢*

WE have a new stock of these tapas, from Samoa. They are made from the bark of the mulberry tree, pounded under water into pulp, dried, and hand painted with the juice of berries. The designs are varied in assorted shades of brown, and the cloths are suitable as wall decorations or table covers.



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LETTERS

Snowsuit Without Snow

SIRS:

Your readers might be interested in the story connected with the accompanying photograph of a weasel, wearing his winter coat at a time when there was not a trace of snow on the ground.

We were following a trail through a stand of lodge-pole pines in southeastern British Columbia last October 30, when I saw this beautiful animal running through the down timber toward the trail ahead of my lead horse. He flowed over the logs like a ribbon of white silk, and on reaching the trail, stood up like a tenpin to look at us curiously. I stopped the pack train to watch him. As though dissatisfied with his view from the ground, he took to a tree to give us a good looking over.

He paid little attention to me when I dismounted and walked closer with my camera. He continued to gaze curiously at the rest of the outfit while I photographed him from about eight feet.

To me, one of the most fascinating aspects of nature is the phenomenon of protective coloration, and this weasel is pictured in the embarrassing position of being clothed in his beautiful white coat without benefit of snow. He showed up in startling contrast to his surroundings.

This picture has additional significance, to which I should like to draw your attention. I am an outfitter and guide, and we are all aware that this profession has long been considered synonymous with the killing of game; but I have introduced a new angle, which has provided endless enjoyment and aroused a growing interest among my friends. I am introducing camera hunting and have induced many to learn of the sport of shooting with film instead of bullets. And I am striving to show the men who follow my profession that, because shortened seasons and smaller bag limits are slowly cutting into the income of guides everywhere, camera hunting provides a wonderful opportunity to increase popular interest in the outdoors and to extend the opportunities through a greater portion of the year.

ANDY RUSSELL.

Twin Butte, Alberta, Canada.

Nature Lovers in the Netherlands

SIRS:

I was delighted to see how many of your readers responded to the notice you published suggesting that young nature lovers might like to correspond with members of the Dutch Youth Association for Nature Study. Many letters have reached us. Not only that, but we were pleased to receive some copies of NATURAL HISTORY and even a gift subscription and membership in the American Museum . . .

This summer, between July 3 and 13, we will have an international field-biology camp at the isle of Terschelling. Though we understand that it won't be easy for Americans to come and attend it, we would be delighted to be able to welcome some of them at this wonderful spot in Holland. The age limit for both boys and girls will be from seventeen to thirty years . . .

HANS ANDREAE.

Leiden, Holland.

Though the camp quota may be full by the time this goes to press, interested readers can obtain further information by writing promptly to Natural History Magazine, 79th Street and Central Park West, New York 24, N. Y.—Ed.

What Is a Robin?

SIRS:

After reading the well-deserved tribute to your Magazine in the April 3 *Time*, it occurred to me that you might be willing to help me and some of my friends in a matter that has bothered us for years, namely, what bird is the true robin.

I am aware of Webster's definition of robin— "a small European bird (*Erithacus rubecula*) of the thrush family," etc., and 2, "In North America, a kind of large thrush (*Tardus migratorius*)," etc. However, this still leaves us with the question as to whether the North American bird is truly a robin or whether it is just so called because it resembles the European bird. . . . And if we must, because of usage, accept the name "robin" for our American bird, is it actually related to the real robin?

To make the subject even more complicated, I lived for some years in the Pacific Northwest, where there is a most lovable and beautiful bird known there as the Marsh Robin. It resembles the European robin much more than the American, but it has a longer tail than either and a redder breast. Many people there consider this bird the real robin, and I can't blame them, because I know of no feathered creature more admirable . . .

ROBERT B. WOOLVERTON.

San Francisco, Calif.

The following comments are offered by

Dr. John T. Zimmer of the American Museum's Bird Department:

Suggestions are occasionally made that our Robin has no right to that name since it properly belongs to a different European species. While the latter part of the statement is true, the name has become so firmly fixed to our bird that it would be difficult to supplant it by another term, even if it were desirable, which is a debatable point. Our Robin was presumably so called by the early English colonists who saw in it a certain degree of resemblance to the well-loved bird of their homeland, and they transferred the old name along with some of the old affection.

It has borne other names in its day: American Fieldfare, Red-breasted Thrush, Fieldfare of Carolina, American Redbreast, and Migratory Thrush. But "Robin" has emerged victorious and is likely to remain. The English bird itself was long called Redbreast in more formal writings, and the affectionate diminutive of "Robert" was added in popular writings and everyday speech to make "Robin Redbreast," possibly in the same vein as "Jennie Wren."

Other birds of the New World were also given names that originally were reserved for European birds. Oriole, Redwing, Tree Sparrow, Redstart, Warbler, Blackbird, and Flycatcher, to cite a few general and specific terms, were given here to birds that are even of different families than the European birds they were thought to resemble. Others, like Goldfinch and Robin, belong to members of the same families, though of different species. When we wish to distinguish the European birds in question, we are likely to prefix "English," "British," "European," or "Old World," while the British, in the same way, call our birds "American Robin," "North American Goldfinch," and the like. As a matter of fact, they call their own Robin the "British Robin" because of the existence of other subspecies on the Continent, one of which reaches the British Isles in winter.

A more troublesome difficulty arises when we and the British use different names for the same species. The respective committees of the British Ornithologists' Union and the American Ornithologists' Union have been attempting to compose some of these differences, and considerable progress has been made, so that greater uniformity is in prospect. There is no need, however, to change the name of our Robin to one of its ancient synonyms or to invent a new term to replace it; and I, for one, hope that no such proposal will seriously be made.

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Watch for Marked Butterflies

The Monarch Butterfly, which ranges over practically all the Western Hemisphere, migrates long distances seasonally. Again this spring the monarchs will be flying north once more. An effort is being made to gather information regarding the migration routes, and toward this end the wings of butterflies in Texas have been marked. Readers of NATURAL HISTORY are asked to keep an eye open for butterflies whose wings bear numbers or other marks. Please report any discovery of marked wings to C. A. Anderson, 3209 Centenary, Dallas 5, Texas. He wants to know the kind of butterfly, the number or other mark, the place, the date, and any other pertinent information. Release the butterfly after examination.—ED.

Golden Anniversary

SIRS:

The Golden Anniversary issue of NATURAL HISTORY is excellent; in truth, every issue is read by my husband and me with much interest, and there is always a race to see which of us gets hold of the Magazine first!

Your editorial, "It's for You to Choose," is a classic in literature. The subject matter is most apt for the moment in history, the way you handled it is superb, and the inspiration—well, it was too good not to pass on, and I have just suggested to the Editor of the *Atlanta Journal* that he should reprint it . . .

MRS. ATHOS MENABONI.

Atlanta, Ga.

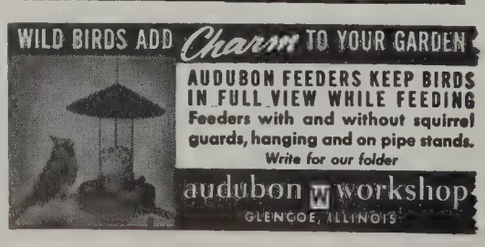
SIRS:

Enclosed please find check for $5.00 for which please send us ten copies of the April 1950 Golden Anniversary number of NATURAL HISTORY. We have in mind to use the copies to deepen the interest in natural history, and perhaps there may be a new regular reader for the magazine.

This order is our testimony of appreciation for your Golden Anniversary number. Every single one of its pages deserves a "Thank you." But we wish particularly to commend Edward M. Weyer, Jr. for his editorial, "It's for You to Choose." . . . Our good wishes reach toward you in your ministry of education.

ROBERT H. *and* RUTH O. MARIS.

Wilmington, Del.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SIRS:

I want you to know how deeply moved I was in reading "It's for You to Choose" in the April issue of NATURAL HISTORY. This editorial should be read by every legislator and minister in the United States. Thanks for putting it all so clearly in so few words.

MRS. LEONARD H. GIDDING.

Plainfield, N. J.

Separate copies of "It's for You to Choose" can be procured at 5¢ each or 25¢ a dozen.

SIRS:

Congratulations to NATURAL HISTORY Magazine on its Fiftieth Anniversary and to its able editors and contributors. May the Magazine always be a cheerful monthly visitor to our many homes and continue to bring pleasure and worthwhile knowledge.

E. B. POWERS.

San Diego, Calif.

SIRS:

May I comment that I personally consider NATURAL HISTORY Magazine one of the best that comes into my home. We subscribe to seventeen magazines (which we turn over to friends or to the hospital after we have reviewed them), and there are only two in this list that I read with regularity. One of them is the American Museum's Magazine, which you can see I consider tops. The articles are invariably on subjects that are interesting, and they are always brief, instructive, and very well written.

DUDLEY S. INGRAHAM.

The E. Ingraham Company,
Bristol, Conn.

"Man in Whale"

SIRS:

I was pleased and amused to see that "we" made *Time* Magazine [April 3] together. Hope it is no source of embarrassment. Had never intended it as such.

Continue to love your Magazine—pine aroma and all.

Your obedient servant,
EGERTON Y. DAVIS, JR.

No address.

Readers will be reminded of the letter entitled "Man in Whale" published in NATURAL HISTORY in June, 1947, and its sequel in September. Not yet having been able to ascertain the whereabouts of Egerton Y. Davis, Jr., we take this method to inform the good "surgeon" that he did not cut us up any more seriously than he did the whale. The wounds have healed nicely.—ED.

NATURAL HISTORY

The Magazine of the American Museum of Natural History

F. Trubee Davison, President | Wayne M. Faunce, Vice-Director, In charge of Publications | Albert E. Parr, Director

VOLUME LIX—NO. 5 | MAY, 1950

Green-clouded Swallowtail ..... Cover Design
A study of a butterfly from a Kodachrome by Chris Olsen

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You will find Natural History *Magazine indexed in* Readers' Guide to Periodical Literature *in your library*

THE COVER THIS MONTH

The Green-clouded Swallowtail is a familiar butterfly of our fields and gardens. The green clouds appear only on the hind wings of the male. The female has blue clouds instead. In this sense, the popular name might be called misleading. Another name for this butterfly is the Spicebush Swallowtail, resulting from the habit of its caterpillars to feed on the leaves of spicebush. But again there is a difficulty, for the caterpillars like sassafras just as well. Linnaeus, nearly 150 years ago, called this butterfly *Papilio troilus*, after Troilus, the son of Priam, king of Troy, whose story is told by Homer in the Iliad. Really, "Troilus Swallowtail" seems to be the best name of all. The caterpillars are colorfully patterned when fully grown, with eyelike spots on the deep green body, on either side of the thorax. They make tubular nests by curling a leaf about themselves for concealment. The Troilus Swallowtail may be found in most parts of the Mississippi Valley and eastward.

William P. Comstock.

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YOUR NEW BOOKS

Nature of Natural History • Maine Woods
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CONGO EDEN

- - - - - by Mary L. Jobe Akeley

Dodd, Mead and Co., $5.00
356 pp., 27 illusts.

CONGO EDEN is the story of Mary L. Jobe Akeley's return visit to the Kivu District of the eastern Belgian Congo, after an absence of 20 years.

In 1921, Carl Akeley had first visited this scenic region of volcanic mountains and heavy forests. He headed an expedition to collect specimens of the mountain gorilla and also the accessories for a group of this animal for the new African Hall, now known as the Akeley Memorial African Hall, in the American Museum of Natural History. He returned to New York very enthusiastic about the country, which he often referred to as "the most beautiful spot on earth." His chief desire was to have these mountains remain unspoiled and their unique flora and fauna saved for posterity. It was largely through his influence that, in 1925, the Albert National Park, the first of the new famous National Parks of the eastern Belgian Congo, was created. In 1926, one year later, Mrs. Akeley accompanied her husband into the Kivu District for the purpose of making additional studies and collecting more accessories for the Gorilla Group, which was nearing completion. While undertaking this task, Carl Akeley was laid at rest in the very spot he cherished so dearly. Fortunately he had seen the beginning of his great ambition—to save the beauty and grandeur of these mountains.

The task of finishing her husband's field work fell upon Mrs. Akeley, and she most ably accomplished it.

In 1946, 20 years after Mary L. Jobe Akeley's first visit to the Kivu, she received an invitation from the Belgian Government to be their guest on a tour of the National Parks in recognition of Carl Akeley's interest in their foundation. The tour would also include a visit to her husband's grave. The invitation was accepted, and *Congo Eden* is her story of this trip.

Mrs. Akeley writes most informatively of the many happenings, including her trip through the Ituri Forest with its pygmies, and her many experiences in photographing big game. She gives interesting facts about the animals, describes the strange types of flora observed, and tells of the interesting people she met. She dwells at length on the accomplishments of the Belgian Government in educating the natives and in the development of agriculture. There are descriptions of the volcanoes and a chapter devoted to her visit to her husband's grave.

Mrs. Akeley has written with her usual easy-to-read, instructive style. I enjoyed the book and am glad to recommend it.

T. DONALD CARTER

A HISTORY OF HORTICULTURE IN AMERICA TO 1860

- - - - - - - - - by U. P. Hedrick

Oxford University Press, $7.50
551 pp., 62 illusts.

DR. HEDRICK'S retirement from the directorship of the New York Agricultural Experiment Station a dozen years ago meant merely a redirection of his activities, which since then have found expression in a series of books. This latest one shows that the passage of 80 seasons has not blunted the enthusiasm of its veteran author. He has ranged widely, gleaning here and there, and has collated his notes into a well-planned survey of early horticulture in the United States (rather than America). The book is as readable as it is informative and will be of value not only to horticulturists but also to students of our national development.

In sweeping over such a wide field, it was perhaps impossible to achieve complete coverage or complete accuracy, but there are some surprising omissions, such as the first Flower Show (Philadelphia, 1829) and the first book on botany (Adam Kuhn's, 1803) or the subsequent course of these subjects. The dahlia is mentioned but not the equally American and more popular marigold or zinnia; also the mulberry but not tea. The invention of the commission box of packeted seeds is rightly attributed to the Shakers, but on a later page to D. M. Ferry 60 years afterwards. Actually the man who promoted the Shakers' idea was William G. Comstock of Wethersfield, Conn., who rode the frontiers with his seed boxes in a wagon. The repeated story of the introduction of sweet corn into New England by Lieut. R. Bagnal has been shown by Erwin of Iowa to be a myth. In the phenomenal rise of this crop the pioneer breeding work in 1836-44 of Judge Noyes Darling, Mayor of New Haven, has been overlooked. The Jerusalem artichoke got its misnomer not from *girasole* but from London hawkers crying it as Ter Neusen, where the crop was grown.

The bibliography is ample but strangely omits Bailey's Cyclopedia of Horticulture, to which the author was clearly indebted. Still, when we have so much in this book, it is almost captious to notice the flaws rather than the excellences with which it abounds. A word of praise is due to the Press for the design and production of a volume which augments its high standards.

F. C. COULTER

THE MAINE WOODS

- - - - - by Henry David Thoreau
Edited by Dudley C. Lunt,
Illustrated by Henry Bugbee Kane

W. W. Norton, $3.00, 340 pp., 72 illusts.

ON the last day of August, 1846, Henry Thoreau left his cabin at Walden Pond for the first of three trips to the Maine wilderness. At the time of his death, in 1862, he was shaping his journal entries and essays into a book, *The Maine Woods*. Edited by his friend, William Ellery Channing, the volume appeared two years later, in 1864.

It has since reappeared in many editions. The most attractive of all, in a number of ways, is the latest, edited by Dudley C. Lunt and illustrated by Henry Bugbee Kane. In previous editions, the book consisted of three separate essays, covering the three trips. By "using the

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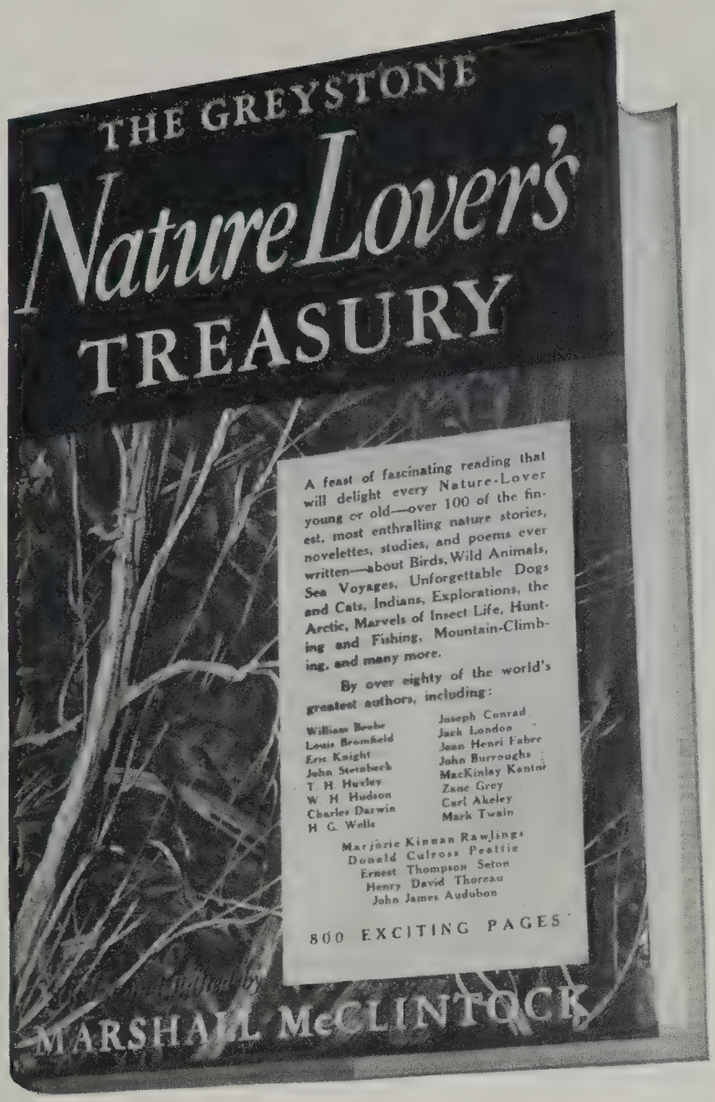
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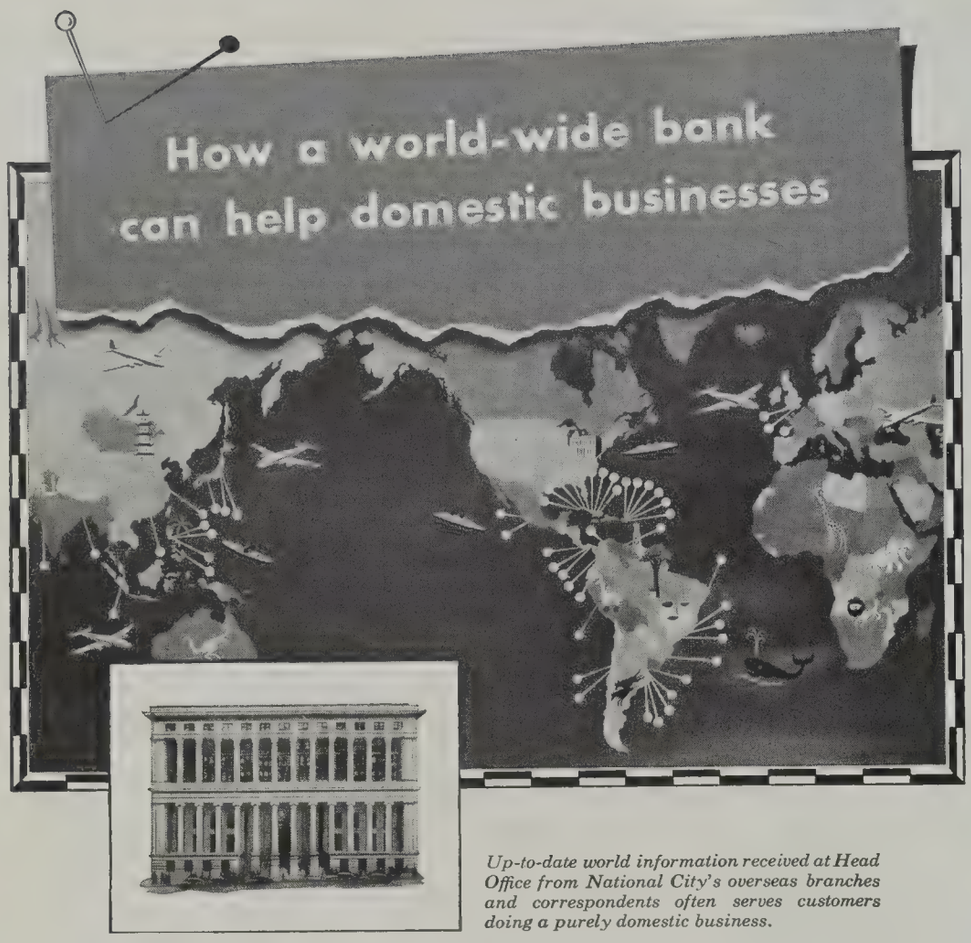

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EVEN if your business interests are local, there are certain advantages in banking with a world-wide institution. The world today is so closely integrated that the condition of markets, finance, and politics overseas often has important influences on business here. It's frequently advisable to consider the world-wide picture before making what appear to be purely local business decisions.

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route followed by the river trip of 1857 and dovetailing into it at the appropriate places the 1853 excursion to Chesuncook and the ascent of Ktaadn in 1846," the editor of the present volume has produced a more consecutive book, smoother to read and ending in the natural climax of the Ktaadn ascent. The gifted Mr. Kane, many of whose Kodachrome pictures have appeared on the covers of NATURAL HISTORY Magazine, has contributed more than 60 black-and-white drawings, 15 of which are given full-page display. In their wide variety, they combine to a remarkable degree dramatic art and the accurate delineation of scenes and wildlife.

While *The Maine Woods* is less philosophical than Thoreau's masterpiece, *Walden*, it contains some of the best forest writing in print. An American poet, recipient of the Pulitzer award, recently told me he considered one short paragraph in the book, describing the sound of a falling tree in the forest, as the most nearly perfect paragraph he knew. You can find it on page 70. In *The Maine Woods*, Thoreau, far in advance of his time, made the first eloquent plea in American literature for wilderness conservation. "Every creature," he wrote, "is better alive than dead, men and moose and pine-trees, and he who understands it aright will rather preserve life than destroy it."

EDWIN WAY TEALE

NATURE CRAFTS

- - - - - - - - by Ellsworth Jaeger

The Macmillan Company, $2.49
128 pp., 70 plates

THIS attractive little book was prepared for campers, outdoor students, and those thousands of persons who are taking training courses in outdoor leadership. Along with schools, universities, churches, state and national parks, many museums are now providing nature courses. Ellsworth Jaeger, Curator of Education and Hayes Professor of Sciences at the Buffalo Museum of Science, has long been interested in nature crafts. This book is replete with easy-to-understand drawings by Mr. Jaeger and simple directions for the making of over 70 interesting nature craft projects. Mr. Jaeger carries on the tradition of Ernest Thompson Seton by interpreting nature through both word and picture.

The shops that supply craft materials may not be too pleased with a book of this type, for all of the materials used to produce the projects come from the fields, woods, and even vacant lots. Nor will the reader need to equip himself with a large assortment of tools. In addition to a pocket knife, only a few tools are needed, such as an ax, a saw, a bit and brace, a gouge, and scissors. Many of the projects are functional, such as a thatched hut, benches, stools, mats,

spoons, gourd dippers, fish hooks, fire makers, turkey callers, candles, match holders, and snowshoes. Other nature crafts provide projects of the recreational type, such as equipment for games like lacrosse and snow snake, the carving of totem poles and Indian dolls, and the modeling of animal figures in clay. This is a crafts book of first quality, which will introduce many readers to a functional and satisfying aspect of their natural surroundings and provide many hours of pleasure. It should be a stimulating antidote for the artificial character of our mechanized and vicarious mode of life.

JOHN R. SAUNDERS

AMERICAN WILD FLOWERS
- - - - - - by Harold N. Moldenke

D. Van Nostrand Company, Inc., $6.95
453 pp., 88 full-color photographs, 67 in gravure

WE have on hand the first volume of "The New Illustrated Naturalist," and it is quite appropriate that this should take the form of a nation-wide treatise on flowering plants. This book represents a very considerable undertaking, for Dr. Moldenke estimates that 30,000 species of flowering plants grow in North America north of the Rio Grande.

He first conducted a nation-wide poll to find out what were the most popular native plants. It will not surprise anybody to know that the cardinal flower and the showy lady's slipper headed the list. Various regional floras were abstracted for descriptions of the interesting, more or less spectacular species that visitors or tourists are likely to find. These plants are described under family headings to give the book scientific integration. Fifty such chapters form the main text, beginning with "Buttercups and their Relatives" and ending with "Orchids."

Some of the Kodachrome illustrations are better than others; the unevenness in quality is probably due to the fact that they have been taken by a large number of people. The black-and-whites are uniformly good, with a fine soft contrasting background, those of the elk grass and Indian pipe being especially handsome. Running comment in these chapters provides information about the plants—how they grow, various types of pollination, their uses, and their geographic distribution. There is an extensive bibliography.

The amateur botanist, for whom the book is intended, may be surprised at the number of scientific names that appear unfamiliar. The author explains in an introductory statement, "Further study has shown the advisability of dividing an old genus of perhaps a great many discordant elements loosely held together by a single or but a few tenuous characters into several smaller but more homogeneous genera." The diversity of names that has resulted is a phenomenon not limited to the botanical field. Then the agglutination of common words into compounds is at times disconcerting—words such as "midasears," "Floridamimosa," "falseindigos," "jobstears," and "adobelily." Nevertheless, the book is beautifully set up, with excellent paper and printing, and the 2000 plants that are discussed will provide a sufficient background for the most insatiable amateur.

HENRY K. SVENSON

THE NATURE OF NATURAL HISTORY
- - - - - - - - - by Marston Bates

Charles Scribner's Sons, $3.50
309 pp.

THIS is an excellent book, strongly recommended to all readers of NATURAL HISTORY Magazine and still more enthusiastically to anyone who may think that natural history is no concern of his.

Since the days of Darwin, Wallace, another Bates (Henry Walter, of Amazonian fame), and the other great naturalists, natural history has been transformed in two directions. The scientist has largely ceased to be a naturalist and has become an ecologist, a mammalogist, a paleontologist, or some other highly special sort of -ologist. To the amateur and the popularizer, natural history has become mainly "nature loving" and its literature is too largely of what Marston Bates calls the "oh my!" variety.

Now Bates proposes to pull natural history together again. For the scientist, here is a large common field among many -ologies, all of which gain by their contribution to a broader synthesis of studies of plants and animals as individuals and in associations. For the amateur, Bates hopes to supplement nature loving with nature *understanding* and to replace "oh my!" with "why?"

This is a tremendous field to cover. Among many other things, it includes the naming and classifying of organisms, their history, their reproduction and development, their environments, their associations, their behavior, their geographic distributions, their adaptations and evolution, and their importance in human economy. The facts are, of course, greatly simplified and generalized in covering so much in one book, but they are never essentially falsified and a real feeling for their trend and significance is conveyed. Moreover, the reader is given a stimulating personal experience. He learns much of the reasons and methods of biological science and of its meaning for him.

All this is conveyed in language so clear that anyone beyond (and some in) grade school should be able to understand it, but so free of condescension that the highest or most learned intelligence will not be insulted.

G. G. SIMPSON

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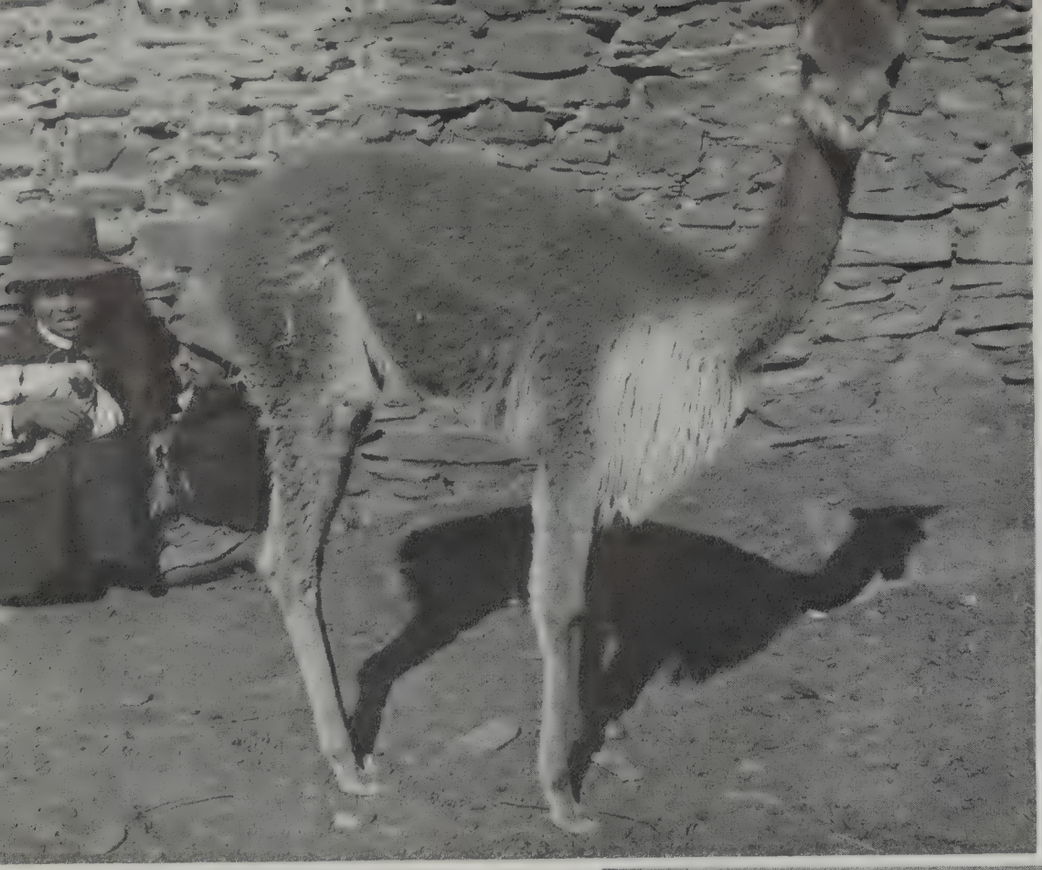


▲ THIS VICUÑA, now grown, was captured with its twin at two months of age when its mother was shot. The photograph shows well the ruff of long hair below the neck

➤ VICUÑALAND: high pampa country at 15,000-foot altitude in southern Peru. This scant, semiarid vegetation typifies the homeland of the little prince among camels. The old volcano El Misti, in the background, lifts its snowcap to a height of 19,110 feet

The little "camel" known as the vicuña, whose superfine wool has been the pride of kings, may provide the basis for a new industry

By WALTER HENRICKS HODGE
University of Massachusetts

Photographs by the author except where otherwise credited

UNLIKE the mythical fleece of Jason, no sleepless dragon guards the haunts of the vicuña, the little Andean beast with the Golden Fleece. Nor need one be a mythological Jason to quest for this regal fleece. Yet only one person in every four million enjoys the beauty and warmth of fabrics woven from the golden-brown wool of the vicuña. Why? Because of scarcity of supply. Though the vicuña may become a plentiful animal under domestication, you may now have to pay upward of $1,000 for a garment made of its wool! Little wonder that most people have never heard of the vicuña, a little camel that often has been called the prince of wool bearers.

This is unfortunate, for the fleece of this animal surpasses in fineness that of any other. A single vicuña hair is less than one-half the diameter of the hair of the finest strains of sheep. Beside it, a human hair would look like coarse wire. Indeed, vicuña is to wools what chinchilla is to furs. It is truly "the most beautiful textile fiber." It is not surprising that this golden fleece, so fine and so regal, was originally reserved exclusively for royalty—the Incas—or that at the time of the Conquest, the Spaniards had a royal quilt made as a gift for their sovereign, Philip II.

Vicuñas, like their close relatives the more familiar llamas, guanacos, and alpacas, are South American camels (Camelidae). Although camels are generally thought of as Old World animals, their ancestral dwelling place actually encompassed large parts of North America,

leece of the Andes

▲ Restricted to a bleak area between 14,000 and 17,000 feet, the vicuña is found only in the shaded region shown in this map

on whose broad plains they developed in large numbers from 12 to 58 million years ago (Eocene to Miocene times). These prehistoric North American camels looked more like their modern South American descendants than like the ungainly humped creatures of Africa and Asia. By the end of the great Ice Age (Pleistocene), camels became extinct in North America but not before they had migrated into the Old World and also into South America, where they evolved through the centuries into two now widely separate and superficially distinct types of creatures.

The vicuña (*Vicugna vicugna*) is the handsomest of our Western Hemisphere camels. It is also the smallest (only two and a half feet high at the shoulders) and the most graceful, being deerlike in appearance and movement. Despite its delicate appearance, the vicuña is actually the hardiest of the Andean camels. Llamas and guanacos cannot stay long at the bleak, blizzard-swept altitudes inhabited by these creatures. Only the alpaca can wander occasionally into these heights. Indeed, save for the rare little deer called *taruga,* vicuñas are the only large mammals in their mountaintop abode.

The vicuña's haunts include the veritable heights of the Andes. Only the line of perpetual snow and ice (which effectively bars the upward growth of animal pasturage) keeps this little camel from clambering above about 17,000 feet on the slopes of some of the loftiest peaks in this part of the world. Wedged in between the snow line on the one hand and the upper limits of crop cultivation on the other (approximately 14,000 feet) lies the belt that the vicuña can call home—a cloud-scraping homeland that averages considerably higher than the summits of Pike's Peak, Mt. Rainier, or the Matterhorn! This treeless land is called *puna.* It is a sort of Andean tundra, with extensive rock fields or semibare earth. It supports sparse bunch grasses called *ichu,* curious mounds of cushion plants, and, in the poorly-drained hollows, vivid green moors of short rushes. These moors serve the vicuñas for herbage, and it is around them that the animals are most frequently seen, particularly in the dry season (April to December).

A Visit to Vicuñaland

Today one can climb by automobile into many parts of the puna country, and if lucky, one can catch a fleeting glimpse of these "substratosphere" camels. But to stalk them away from the road across the high pampas is another matter. Even on the level, the breath of the average person, in an atmosphere drained of life-giving oxygen, comes in short gasps. *Soroche,* or mountain sickness, except for the barrel-chested, big-hearted highland Indians, is an ever-present worry. Like the Indian, the vicuña is attuned physically to life at high elevation. So specialized is this creature that if transferred to sea level it often sickens and dies.

One might think that in a treeless area where the highest bunch-grass clump is scarcely two feet high, vicuñas would be easy to see. On the contrary, except when in motion or when silhouetted against the sky, they are practically invisible, so well does the color of their fleece blend into the perennially-drab brownish aspect of the puna.

The coats of llamas and alpacas, through endless selection in domestication, have become diversified so that one sees various combinations of browns, blacks, grays, and whites. But the undomesticated vicuña has only a single constant color pattern. This is so beautiful a gradation of hues that when fabricated it is rarely dyed. Rich chestnut-brown is the dominant color covering the upper parts of the head, neck, back, flanks, and legs. As it passes to the underparts, this hue is diluted to a soft, golden fawn color and finally to white on the belly and the inside of the thighs. Also light is the short wool of the jaws and face. But perhaps the most striking feature of the adult animal is the conspicuous ruff of long, soft, white hair which, partially surrounding the base of the slim neck, falls down over the chest and makes the dainty forelegs appear to project from wispy plumes of wool, giving an almost birdlike aspect. The white ruff is a sign of maturity and is lacking in lamb vicuñas, which, however, show signs of where the ruff is to appear. Moreover, lambkin vicuñas are much lighter in color—all fawn—and softer coats than theirs are hardly imaginable. They surpass in fineness and silkiness even those of their parents, a fact that was put to practical use by the ancient Peruvians, who made special fabrics from such fleeces. Alpaca hair also varies according to age, sex, and location, and some alpaca hair is actually finer than the thicker vicuña hair.

On the puna, vicuñas run in small

▲ OVER THE RIM of these giant walls of central Peru lies the lofty domain of the little camel with the golden fleece

groups of from six to twelve animals. These are all females and young except for the leader, which is a vigorous male. Over a century ago, the distinguished Swiss zoologist Von Tschudi ably described the daily activity of such a vicuña family group: "Whilst the females are quietly grazing, the male stands at the distance of some paces apart and carefully keeps guard over them. At the approach of danger he gives a signal, consisting of a sort of whistling sound and a quick movement of the foot. Immediately the herd draws closely together, each animal anxiously stretching out its head in the direction of the threatening danger. They then take flight; first moving leisurely and cautiously, then quickening their pace to the utmost degree of speed; whilst the male vicuña, who covers the retreat, frequently halts to observe the movements of the enemy. The females, with singular fidelity and affection, reward the watchful care of their protector. If he is wounded or killed, they gather round him in a circle, uttering their shrill tones of lamentation, and they will suffer themselves to be captured or killed rather than desert him by pursuing their flight. The neigh of the vicuña, like that of the other animals of its class, resembles a short, sharp whistle. But when the shrill sound vibrates through the pure puna air, the practiced ear can readily distinguish the cry of the vicuña from that of the other animals of the same family."

Von Tschudi might have added that, like many wild things, vicuñas seem to have a big bump of curiosity, which undoubtedly has led

➤ TENDING BABY while she shears a hobbled ram, this Indian woman of Ayavaca, Peru, cuts the wool with a crude knife blade in exactly the same way in which her ancestors sheared wild vicuñas

more than one to its demise. Upon the approach of anything strange, instead of running straight away, they lope off a bit and turn to observe. If no danger is apparent, they generally approach cautiously and linger for a long while. The writer, when traveling by car, has more than once come upon such a group. They seemed to consider the automobile inoffensive, in fact worthy of investigation. But as soon as a person stepped out, the group would hurry off over the horizon. Their fleetness has been their safety. This, together with the absence of firearms among the highland Indians and the stringent laws that supposedly protect them, accounts for their survival today. For certainly an animal with a golden fleece so valuable would long since have been exterminated in the centuries following the Spanish Conquest.

Ancient Conservation

Actually, the vicuña was better protected before the conquest of Peru than it is today—protected by this hemisphere's (and possibly the world's) original conservationists, the Incas. Their civilization recognized the value of vicuñas—and all other game—and enacted laws accordingly. These laws worked, too, for under the Incas anyone molesting one of these little camels, except in one of the orderly state-run hunts, was subject to death. One might say that the vicuña was a royal animal. Dainty vicuña figurines were wrought in gold, silver, and stone; and vicuña fleece was woven into fabrics reserved only for the nobility.

Vicuña fabric of any sort was called *cumpi* by the Incas. Much of it was woven by men, the so-called *cumpi-camayoc-cuna,* on curious upright looms that have long since disappeared. Certain types of *cumpi* were better than others, that from lambkin vicuña surpassing that from adult fleece. The finest *cumpi* was woven by the chosen women (*acllacuna*) or Virgins of the Sun, the Incas' handwomen. It is even said that they improved it with the even silkier hair from bats, of all things. But little credence can be placed in this story, because the longest fur from any Peruvian bat is only 7 or 8 mm. in length, and spinning such a short staple by hand would be impossible.

▲ Compared to the poodle-like alpaca (*right*), an adult vicuña is a dainty, deerlike creature. However, its depressed ears are a warning that a wad of spittal is about to be sent in someone's direction

Vicuña wool, in preparation for thread making, was washed in water but never thoroughly. The natural animal oils were valued, in combination with the spinner's saliva applied by the thumb and forefinger, to produce a woolen thread that was remarkably pliable and smooth. The ancient process of thread making has been handed down to the modern Indians, and wherever one sees them, even when they are backpacking burdens or children, one may spot the ever-present distaff and whirling spindle.

From the hands of the chosen women of ancient Peru have come some of the finest wool textiles ever made anywhere in the whole world. Before Europeans reached South America, thread was being spun and woven by Andean Indians into tapestries so fine as to show a weft count of 350 weft threads to the

▲ A WOOL BELT being woven by Indian girls of Sandia, Peru. This is a variant of the backstrap loom, in which tension is varied by leaning back on a strap around the weaver's waist

▲ A BACKSTRAP LOOM of a type used in Peru today. On such lo fabrics of almost all types can be if the weaver has skill and patie

inch. Yet the best that modern man has been able to produce from fine vicuña wool is a weft count of 90! The rarity of true vicuña weavings is shown by the fact that, although there is no doubt of their existence in ancient times, we know of no unquestionable example among the collections in museums. Many pieces have not been subjected to the specialized microscopic analysis that is necessary to ascertain the identity of vicuña hair, but the ones that have, have proved to be alpaca. Unfortunate it is that such a luxury art as that of *cumpi* weaving was suppressed by the Spaniards and its technique of manufacture lost through the centuries, perhaps forever.

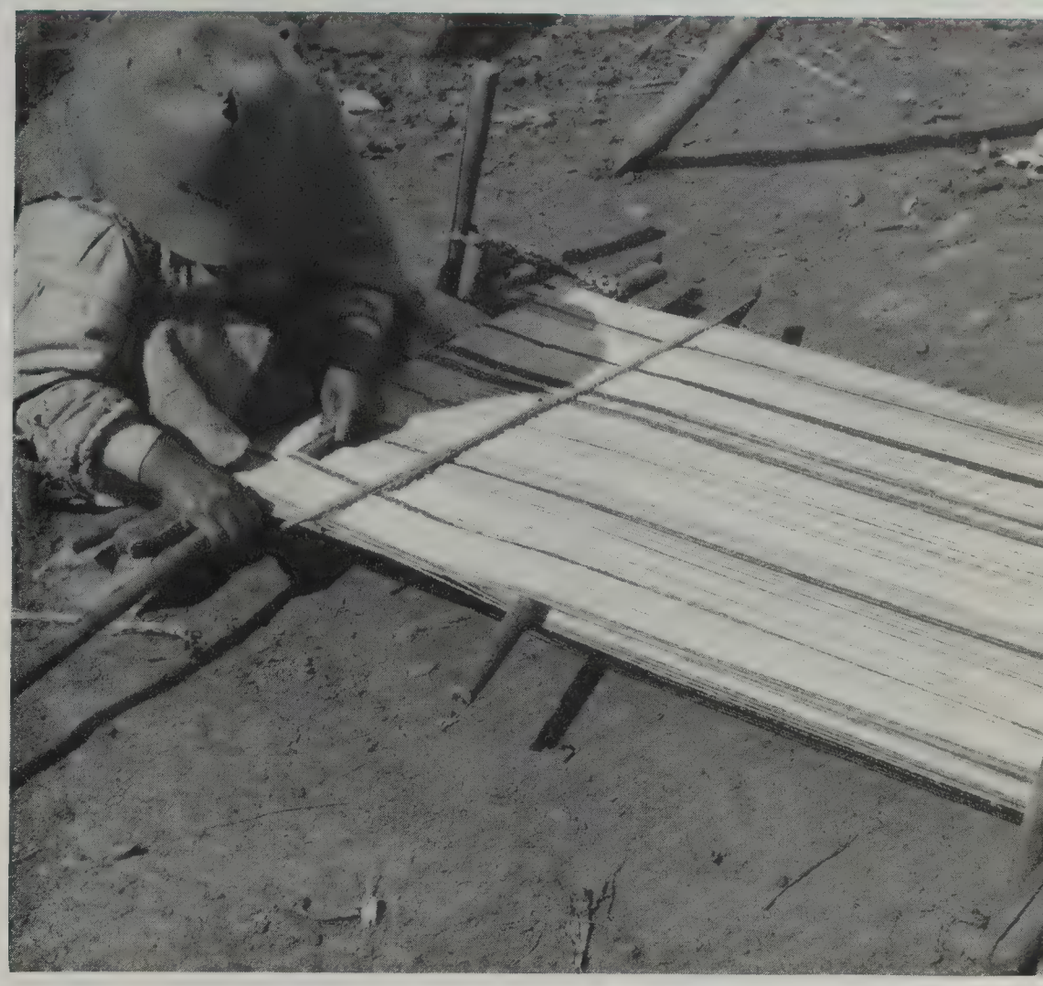
In Inca times vicuña wool was obtained systematically during one of the great public hunts called *cako* or *chacu*, sporting events that were held periodically and served not only to reduce the surplus game but also to increase the meat supply. We have an authentic account of one of these imperial hunts, for one was organized in honor of Pizarro by Manco Inca. In this particular hunt more than 10,000 Indian beaters surrounded an area approximately 50 miles in circumference. Closing in gradually, they drove all encircled animals into a common center, and when the human net was tight enough and small enough, designated hunters entered to kill the animals required. Of the animals thus trapped, only the vicuñas were ordinarily taken alive and shorn, presumably being hog-tied during the process. Simple bronze or copper knives, the only metal tools available, were probably used in the shearing. And even today a simple knife is the shearing implement of the highland Indian in vicuñaland.

Did the Incas attempt the domestication of this beast with the golden fleece? As they had no written language, we can only say we do not know. But since ancient Peruvians domesticated the closely related alpaca and llama, we might guess that they tried to tame the vicuña and failed. Or, since vicuña wool was reserved for the royalty, perhaps it was better left a relative rarity to be obtained from the wild only through the medium of the public hunt.

The Threat of Extinction

With the conquest of the Incas by Europeans, all their strict and able conservation practices failed. The Conquistadores could scarcely believe that the fine vicuña textiles that fell to their plundering hands were made from a wool. Instead they thought it was some New World kind of silk. As with the other riches of Peru, greed got the best of the conquerors. No sooner had

VERTICAL LOOM used by select men
ers for making fine tapestry cloth.
type was last used shortly after
Conquest



▲ A WOOL PONCHO, universal outer garment of the highlands, being woven on a loom stretched between stakes. Ponchos made of vicuña cloth are still highly prized, being noted for lightness, softness, and well-nigh impermeability to rain

they learned of the true source of this New World "silk" than slaughter of vicuñas became wanton. The animals shortly approached the verge of extinction, if one is to believe the writers of the time. By the beginning of the nineteenth century, the time of Peruvian independence, the stock of these little camels had been so decimated that in 1825, Bolivar enacted a decree prohibiting their killing. The Liberator further offered prizes—without success—for the vicuña's domestication.

Compared with Inca times, the vicuña population was sadly depleted, but possibly it is erroneous to say it was on the verge of extinction. For there are so many isolated, uninhabited *refugia* in the high puna country, even today, that to kill all the vicuñas would seem to be next to impossible. Von Tschudi, who was certainly a careful scientific observer, noted about this time (1838-1842) that "frequent hunting seems not to have the effect of diminishing the numbers of these animals . . ." In the altos, he said, they were still found in vast numbers. The same writer took part in a variation of the old Inca hunt, which apparently is still promoted today, occasionally and furtively, by the highland Aymara Indians of the Titicaca area. Von Tschudi's description is worth quoting:

The Hunt

"In this curious hunt, one man at least belonging to each family in the puna villages takes a part, and women accompany the train, to officiate as cooks to the hunters. The whole company, frequently amounting to seventy or eighty individuals, proceed to the altos (the most secluded parts of the puna), which are the haunts of the vicuñas. They take with them stakes and a great quantity of rope and cord. A spacious open plain is selected, and the stakes are driven into the ground in a circle, at intervals of from twelve to fifteen feet apart, and are connected together by ropes fastened to them at the height of two or two-and-a-half feet from the ground. The circular space within the stakes is about half a league in circumference, and an opening of about two hundred paces in width is left for entrance. On the ropes by which the stakes are fastened together the women hang pieces of colored rags, which flutter about in the wind.

"The *chacu* being fully prepared, the men, some of whom are mounted on horseback, range about within a circuit of several miles, driving before them all the herds of vicuñas they meet with, and forcing them into the chacu. When a sufficient number of vicuñas is collected, the entrance is closed. The timid animals do not attempt to leap over the

THOUGH NOT a single sample of ancient vicuña weaving appears to have been identified by actual tests, this remarkable tapestry border of alpaca illustrates the exquisite weaving of the late Chimu period (A.D. 1000-1400). Colors are crimson, deep pink, yellow, black, and white, and they are woven with superb symmetry and harmony

SPINNING VICUÑA WOOL by the ancient method handed down from Inca times: a highland woman using the typical wooden distaff in her left hand and the spindle in her right

ropes, being frightened by the fluttering rags suspended from them, and, when thus secured, the Indians easily kill them by the *bolas*. These bolas consist of three balls, composed either of lead or stone; two of them heavy and the third rather lighter. They are fastened to long elastic strings, made of twisted sinews of the vicuña, and the opposite ends of the strings are all tied together. The Indian holds the lightest of the three balls in his hand, and swings the two others in a wide circle above his head; then, taking his aim at the distance of about fifteen or twenty paces, he lets go the hand-ball, upon which all the three balls whirl in a circle and twine round the object aimed at. The aim is usually taken at the hind legs of the animals, and the cords twisting around them they become firmly bound. It requires great skill and long practice to throw the bolas dexterously, especially when on horseback: a novice in the art incurs the risk of dangerously hurting either himself or his horse, by not giving the balls the proper swing, or by letting go the hand-ball too soon.

"The vicuñas, after being secured by the bolas, are killed, and the flesh is distributed in equal portions among the hunters. The skins belong to the Church." The chacu hunt described by Von Tschudi took place in the altos of Huayhuay, and during the five days of the hunt, 122 vicuñas were caught.

Laws to Protect the Vicuña

During the hundred years since Bolívar first acted to conserve the vicuña, protective laws have been sporadically reinacted by the Peruvian government. Rigid control of hunting is impossible in a country without game wardens, but these laws are certainly a step in the right direction. As recently as 1940, a decree was passed prohibiting the killing of vicuñas or the possession of any articles made from their skin or wool. That the law has its infractions may be judged from the fact that a traveler in puna territory may easily, if at times furtively, acquire articles from the natives such as vicuña-skin robes, hats made of vicuña felt, or vicuña woolens. Although obtainable, they are diffi-

cult to get out of the country except with official permits. Moreover, nearly every highland village boasts of one or more tame vicuñas, animals usually captured as lambs (when a female is killed) and then reared as pets.

Despite these minor infractions of the law, the vicuña is fortunately not uncommon today in some places, especially in the outlying fringes of the altiplano. Although listed in 1942 as a vanishing mammal of the Western Hemisphere, the present status of this little camel is hardly that. In Peru alone, estimates of the wild vicuña population run from a conservative (and more probable) fifty thousand animals to an optimistic million. These figures are little more than guesses.

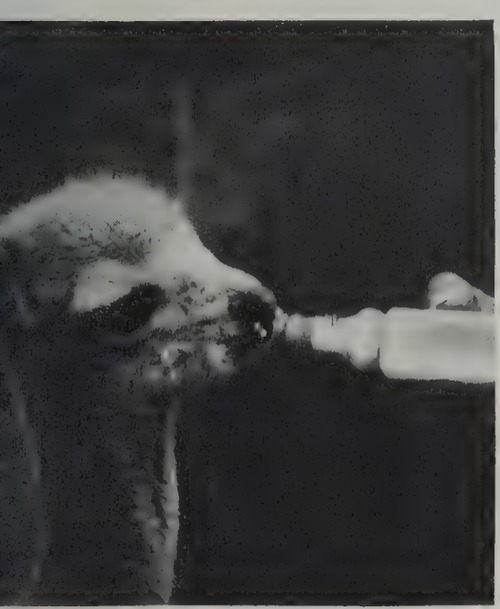
Attempts at Domestication

Modern Peruvians are showing signs of accomplishing what the ancient people failed to achieve—the domestication of this beast with the golden fleece. If practical, this should bring a new and profitable industry. Several large private haciendas in Peru's state of Puno already have small experimental flocks of vicuñas for husbandry study. Most of these animals were captured by running them down on the puna with horses, a difficult job. Peru's National Board of Wool Industry is behind these studies. Even with abundant terrain for their project, problems still exist. Though easily and frequently tamed, vicuñas usually refuse to breed in captivity, thus making the building up of a commercial flock most difficult. But if given ample space, simulating wild conditions, it has been found that vicuñas may breed within a fenced area.

Sizable flocks are needed, because the little beasts produce only about a third of a pound of fine wool per adult animal. About a third of this represents the longer beard hair comprising the vicuña's outer coat—useless in fine textile manufacture. The remaining two thirds, about a quarter of a pound all told, is the silklike inner hair yielding the stock for fine vicuña fabric. Thus the annual wool production from a pioneer flock of 300 domesticated vicuñas is only 100 pounds, barely enough to make half a dozen fine coats. No wonder yardage of vicuña fabrics is valued in the hundreds of dollars!

To increase the wool production, experiments have been made in crossing the vicuña with its cousin the alpaca, the most important of South America's "camels" as far as wool production is concerned. Such hybridizing has been successful, and the hardy progeny of these crosses, known as paco-vicuñas, show the heavy wool production of alpacas with some of the finer characteristics of vicuñas. Unfortunately, the characteristics of the original cross do not hold in succeeding generations, the wool decreasing in value to such an extent that hybridizing has been given up.

Widespread vicuña domestication may still be a thing of the future, but it must eventually come. Highland Peru and Bolivia can well afford to develop a luxury industry such as this. Once the civilized world has seen the superb qualities of vicuña wool, it will surely demand fabrics originating from this prince of wool bearers, the little Andean camel with the Golden Fleece.



A LOVABLE VICUÑA ORPHAN, two weeks
d, being reared on cow's milk

➤ THE VICUÑA is graceful in motion and has been seen to keep up with trains of the Southern Railroad of Peru

CLOWN FISH

Serving as nursemaid and provider for a vicious "sea flower," this gorgeous little fish enjoys the comfort and safety of a well-armed castle

By Woody Williams

Photos by the author, courtesy Steinhart Aquarium, California Academy of Sciences, San Francisco

IT is not uncommon for an aquarist to be accused of touching up his tropical fish with a paintbrush—especially if the fish are damselfishes (Pomacentrids), such as *Amphiprion percula*. These pygmy beauties, about three inches long, are bright orange with bizarre stripes of white, and their fins are tipped with black. They come from the Indo-Australian coral reefs of the western Pacific. Because of their slow, clumsy "gait" and flamboyant color patterns they have been named "clown fish." But to the biologist they are more than comical oddities from the South Seas. As partners of the large sea anemones, they represent one of nature's most astounding examples of symbiosis—the close association of two dissimilar organisms for mutual benefit.

Symbiosis is not rare in nature, but there are few examples where the relationship seems so intimately integrated as among the damselfishes and the large sea anemones, such as *Stoichactes*, among whose tentacles they make their home.

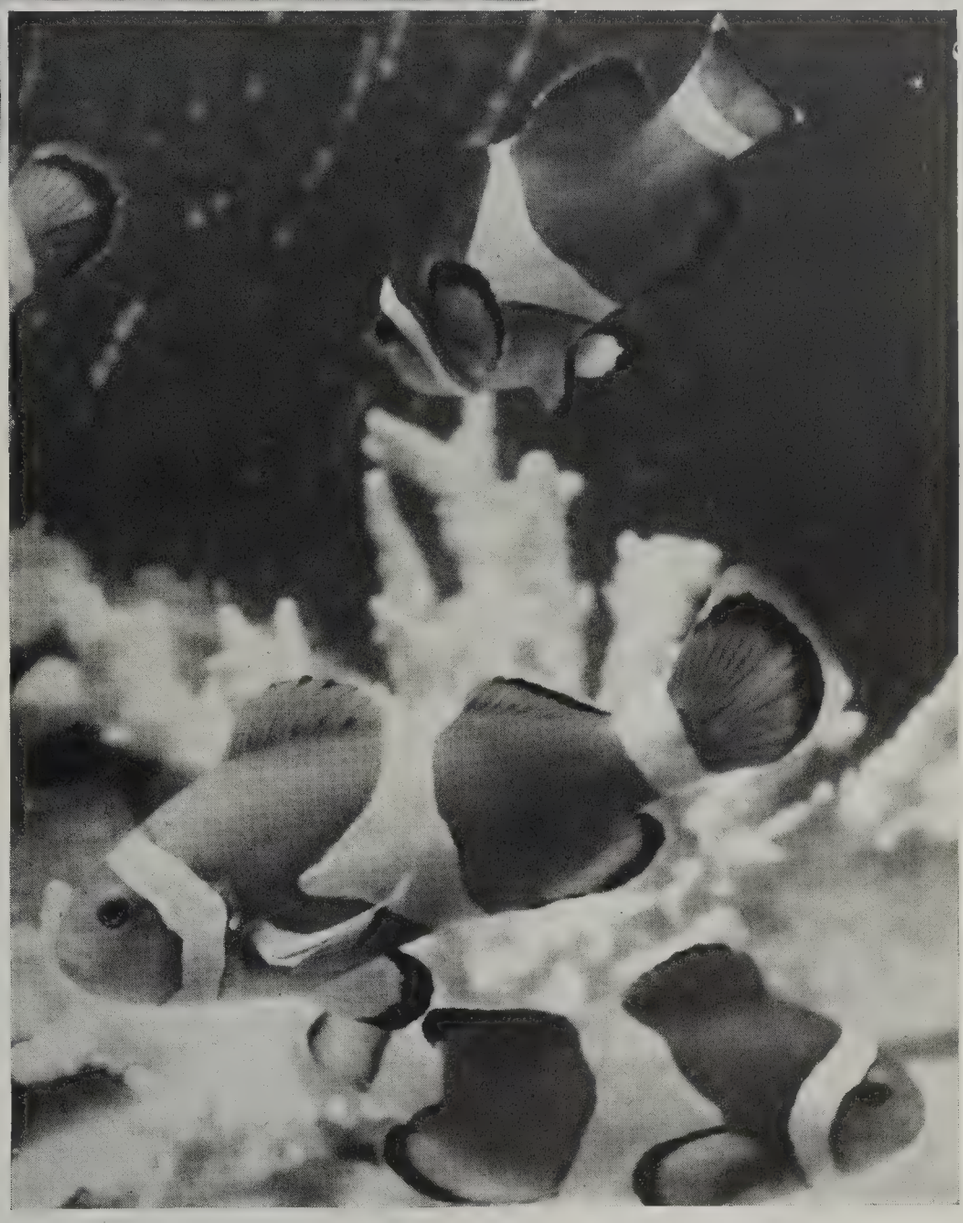
▲ BRIGHT ORANGE with conspicuous white stripes, the clown fish attracts much attention in the aquarium because of its beautiful appearance. But its extraordinary habits are even more startling

These petal-like tentacles, to all appearance as innocent as a daisy, actually possess the stinging power of a nest of hornets. Some of the tropical anemones are known to inflict painful wounds on man, to say nothing of their potency against lower creatures of the sea. The instrument that produces such effective results is a comparatively complicated one-celled structure called a nematocyst, present in countless numbers. These stinging cells eject a dart which, when it pierces the tissue of an unlucky visitor, injects a poison that often causes pain or death. Yet the damselfish nestles among these lethal tentacles with perfect safety. Indeed, the fish's very existence on the reef would be questionable if it were not able to seek refuge among the anemones without bodily harm. If deprived of its hiding place, it would become easy prey to larger forms, for it is a slow swimmer and its gaudy suit is conspicuous.

Apparently these fishes are immune to the poison of the stinging cells. But not just any anemone with an effective battery satisfies a given species of damselfish. Each kind of damselfish restricts itself to one or sometimes a few species of anemones, the choice depending probably to some extent on appropriate size. The marine biologists in Java who have studied *Amphiprion* and related forms most extensively have learned to predict which species of damselfish will be found in given types of sea anemones.

They have also found that damselfishes are primarily individualists. Once a pair of clown fish have

LIKE BEAUTY AND THE BEAST, the strange relationship between the gentle clown fish and the lethal sea anemone progresses happily —with curious benefits to both parties



THE HOME of the clown fish is among the acles of the sea anemone, which contain ging cells that are often fatal to creatures ne sea. Yet this fish nestles here in perfect ty

established a home in an anemone (or a group of anemones), they tend to maintain the territory for themselves. However, young clown fish are sometimes found in the same anemones with adults, who perhaps did not have the persuasive power to evict the youngsters.

Some relatives of the clown fish are quite emphatic in their defense of home. This trait sometimes leads to their capture. When a diver descends near their home, they will rush out from the anemone and nip his legs, shoes, and net, thus exposing themselves to easy capture. Generally, however, the clown fish will hide in the disc of the anemone, remaining there even after the anemone is lifted from the water, and in this way they can be collected. Such a clown fish, together with its anemone, lived for years under the care of a woman in Philadelphia, according to Frederick H. Stoye, who writes on tropical aquarium fishes.

The species of *Amphiprion* shown in these photographs is believed to pair off for life. The female outdoes the male in size, and following a tendency that some think they detect in human society, she is the aggressive suitor. Nipping each other's flanks is one of the favorite courtship pastimes. The male cleans off a hard surface at the base of the anemone, and the female deposits 200 or 300 eggs. The housekeeping is done by the male. After the eggs have been laid, he rubs against the tentacles of the anemone, directing them downward so that they camouflage the eggs. This ability of the clown fish to direct the actions of the anemone is one of the most remarkable aspects of their relationship.

Many details in the later development of the young *Amphiprion* are still concealed in the mystery of reef life. However, the Netherlands scientists are quite certain that after hatching, the young swim to the surface and feed on tiny floating or weakly swimming animals. Many *Amphiprion,* in turn, are of course preyed upon by larger creatures in this combination nursery and hunting ground at the surface of the sea.

In a short time, the survivors of this vertical migration drop again to the bottom and search out anemones in which to set up housekeeping. If the anemones are scarce, several clown fish may congregate in one.

For a time, the clown fish feeds on minute bits of life captured by the tentacles of the sea anemone. But as it matures, it probably

again depends primarily on floating organisms passing near its home. In captivity, *Amphiprion* appears to do well on *Artemia,* otherwise known as brine shrimp, which are collected from highly salty waters or hatched out from eggs in salt solutions in the laboratory or home. In nature, the clown fish's feeding habits are not well known

One species of damselfish is known to carry morsels of food to its anemone and place them among the tentacles. Even more astonishing is the report that a damselfish has been seen to "nurse" a sick anemone back to health by fanning it and rubbing against it, a situation that is said to occur when the sea water becomes unfavorable to the anemone's health. The anemones seem definitely to do better when accompanied by their damselfish. On the other hand, damselfish have occasionally been observed to feed on the tentacles of the anemone that shelters them, and it has been suggested that this habit builds up an immunity to the poison.

Such, in brief, is the strange partnership between these two fascinating animals that dwell together on the bottom of the sea. The average man, lacking the elaborate equipment used by the undersea explorer, can nevertheless observe their strange behavior in some of our public aquaria. One cannot fail to imagine what fascination they would hold as household pets in the home fish tank. But these are creatures of the sea, not of fresh water. Last year, two shipments of *Amphiprion* came into the United States through San Francisco, but the great losses that were suffered in transit across the Pacific caused further efforts toward importation to be dropped. So the best thing one can do is to ask whether he can see the clown fish and its strange partner the next time he visits a large city aquarium.

Anyone wishing to learn more of this strange partnership will be repaid by reading Dr. E. W. Gudger's comprehensive paper in the *Journal of the Royal Asiatic Society of Bengal* (Science), Vol. XII, 1946, No. 2.

Animals of th

High among the rock-strewn slopes, four furry alpine animals will soon emerge from their snow-bound castles to enjoy a brief season of sunshine — spring, summer, and fall crowded into one

By Tom McHugh

All photographs by the author

E CONY, OR PIKA, makes hay while the hines and then luxuriates beneath the . Photographed in early July, this seven- animal shows only one remnant of its winter coat—the light patch on its hind ers

➤ UNDER as much as ten feet of snow, the higher slopes of the Rockies are slow to welcome summer. Protected by this blanket, the mountaineering mammals either hibernate or subsist on stored food

valanche

A SHORT alpine shower had temporarily slowed our pack trip on its way over a mountain pass in the Rockies. Brief yet violent, this storm spent its force in less than an hour. Clearing skies again brought quiet to the high country—but not for long . . .

Soon we were startled by a sound that began like the roar of distant thunder. Rapidly becoming louder, the din threw the area around us into turmoil. Our horses reared up in fright. Small animals scurried for shelter. At that moment we witnessed the greatest spectacle in the struggle between weather and the mountains:

Avalanche!

Rock jarred by the recent storm had just toppled from a high crag to start a cascade of boulders, which gathered more force by the second. This river of rolling rock poured destruction down the mountainside next to us. Like the spray from a waterfall, a cloud of stone powder rose from the grinding landslide. Small clumps of trees were snapped like matchsticks. This thunderbolt of boulders finally stopped when it hit more level ground on the valley floor below.

Then only the burned smell from the grating rocks called to mind the ruin on the slope before us. It was a picture of confusion—confusion in the tangled mass of rock and confusion in the fact that this avalanche had actually been a godsend to a group of alpine animals. Oddly enough, the rockslide had made more homes for these creatures.

Such piles of rocks or talus, as they are called by geologists, form a very secure fortress for four ingenious creatures: the pika, the marmot, the golden-mantled ground squirrel, and the bushy-tailed wood rat or pack rat. Using rock piles as secure homes, these mountaineering mammals can survive the rugged alpine life on our western snow-capped ranges.

A quick glance at the talus slopes leaves an impression of bleak desolation. "How could anything possibly live on that barren desert of rocks?" asked my companion. But he failed to look closely. Here and there in bits of soil among the boulders small plants can eke out an existence. With tiny leaves and stems, they devote most of their energy to large colorful flowers. Greenery growing in the lush mountain meadows next to the rockslides fares better, for it is usually fed

➤ A MARMOT, alert for danger atop a lookout post. Should enemies approach, he will quickly sound his alarm, and all marmots roundabout will dive into their rock castles

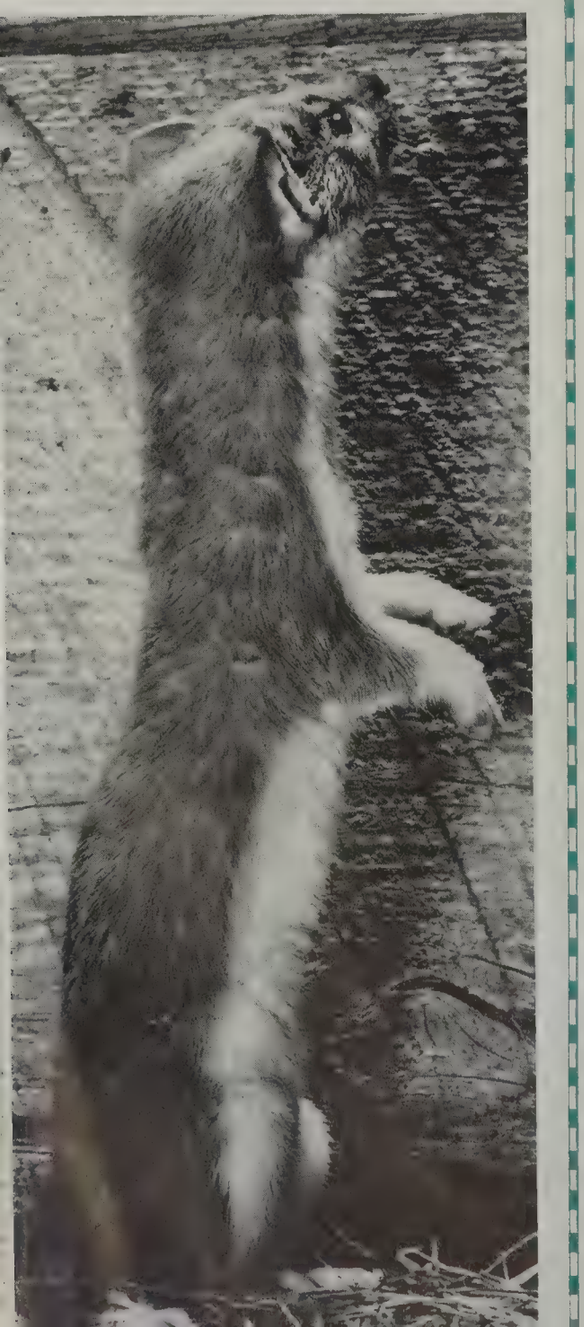
ROCKSLIDES like this one, the marmot, wood rat, and golden-mantled ground rel make their homes. You can find them as high as the snow fields on the distant

from the water of countless melting snow fields.

Higher up, near timber line, the picture does become more desolate, however. Trees that are about 100 years old grow no more than waist high. They are stunted by the short growing season, the strong dry winds, and the low temperatures. As we climbed above the last remnants of these trees, other plants also became scarce. In their place, ice filled the cracks between the rocks. We were forced to wear gloves even during midday, the rocks were so cold. And the brisk alpine breeze didn't help matters. "I guess we've seen the last of any animal life," I was finally forced to remark to my friend.

▲ THE GOLDEN-MANTLED GROUND SQUIRREL is the most colorful of these alpine animals. The bright rufous color of the head thins out down the back but appears again in the tail

▼ THE WEASEL—probably a more serious enemy than the foxes, wolves, bobcats, and other larger creatures that prey on the little animals of the avalanche



But I was wrong.

As we struggled to the peak of the Grand Teton, we found tracks. Running across a large snowbank at an altitude of over 13,000 feet, they showed where a pika, or cony, had wended its way in search of food. Conies have been found even higher than this. They occur up to an elevation of 14,254 feet in the Sierra Nevada range – almost 3 miles above sea level!

Lower down, around timber line, these alpine animals make their best stand. Although their talus slopes appear bare and abandoned at first, the occupants quickly let you know that someone is home. As an intruder and potential enemy, you are greeted by a chorus of sounds. These alarm notes are the telegraph system of the rockslides.

The most unusual call sounds like *"enh"* and seems to say *"Yeah?* Mind your own business!" It has what speech teachers would call a "nasal twang." But more than anything else, it is confusing because it is difficult to localize. The sound seems to come from nowhere on the talus slide, until finally the originator moves about and reveals himself to be a pika. His head points skyward like a baying wolf, his feet shuffle, his ears twitch upward, and his shoulders move forward as if to expel more air from his lungs—and out comes another *"enh"!*

The pika's call alerts the marmots, or rock-chucks, who burst forth with a volley of sharp whistles. The whistles don't seem to be alarm notes at all. Rather, they express doubt or inquiry. Other marmots in the vicinity climb to vantage points on the rocks to see what's happening. Then, if danger really threatens, the sentinels sound the alarm call, a coughed *"keyuck."* This immediately sends all marmots to the depths of their rock castles.

The golden-mantled ground squirrels also have a language all their own, even though it isn't as obvious. Chittering buzzes, grunts, and rasping notes convey their feelings, especially during fights. Danger brings forth explosive alarm notes that sound like a whistled chirp. *"Tsp,"* they proclaim, and their whole body reflects concern with a nervous tail-twitch. Other squirrels in the area hear the call and come to attention, standing up on their hind feet and clasping their front paws together. It is the very picture of a minister in the pulpit ready to give a sermon.

Even though wood rats come out only at night, they also have a telegraph system. When danger draws near, a hind foot or the end of their tail rapidly vibrates on the ground. As the first rat thumps out an alarm signal, other rats within thumping distance pick up the message and relay it to still others within hearing. All animals are then on the alert to escape if enemies should come their way.

Wood rats also leave messages in another unusual way. A special gland below the tail produces a strong musky scent, and wherever the rats go, they may leave a bit of this odor to mark the place. It may serve to label the territory of one rat and warn other individuals to keep off, and it may also help indicate trails so that they may be easily followed on dark nights.

Different as are the ways of life of these four mountaineering mammals, and different as are their alarm calls, these creatures are still one family. They may depend on each other to give an alarm note. More than that, though, they are one family because they all live in the most secure home in the mountains, the grottoes of the talus slides. And they realize the protection given by their rock castles.

Although conies will travel some distance among the rocks for food, they seldom venture far beyond these rock boundaries. When not busy finding food, they like to sit

▲ AN ENEMY of the denizens of the rockslides: a young red fox whose mother had just killed a marmot

▼ WITH HIS BIG EARS, fluffy fur, and bushy tail, the wood rat is a captivating member of the alpine quartet and need never be confused with the house rat. It has been known to collect almost everything from mousetraps to false teeth

on some prominent boulder where they have a wide view of the whole slope. This is the crow's-nest of their rock fortress. When a golden eagle —or some other enemy "plane"— circles near, their air raid sirens go into action. A series of rapidly repeated "*enh's*" broadcasts the warning, and then they tumble back into the rocks—a veritable bomb shelter.

Conies live all over the rockslides, but marmots prefer to build their den in a group of rocks near more vegetation. Here they cleverly locate their burrow between two boulders so that there is just enough room for a marmot to pass through. The tunnel is small enough to keep out larger enemies like wolves and coyotes.

While one marmot keeps a lookout on top of the rock pile, others from the den bound along like little pigs into the mountain meadows. Well-marked trails lead from the rocks to the feeding grounds in the flowered fields. If the distance is several hundred feet, a temporary burrow may be placed at the halfway point. This will serve for momentary protection until the danger is gone or until they can make a rush for the home den.

Golden-mantled ground squirrels, or "callos" as they are called for short, make their homes under the rocks near the bordering woods. They shun the deep shade of dense forests, however. Home is a little hole in the ground two or more inches in diameter and under the rocks.

There the young are born in spring or early summer. Once large enough, they emerge and romp in the sun near the burrow. When danger threatens, their mother rushes back and pushes them down into the hole with her forepaws, but innocent of the enemies in the upperworld, they rapidly pop out again when mother goes away. When bothered by too many people, I have seen a much disturbed mother pick up the young in her teeth and move them to a safer burrow.

The bushy-tailed wood rat builds his home in crevices in the rocks or in near-by cabins. The home provides protection and serves as a nursery and as a storage place for food. Above all, however, it is a "museum," for the wood rat is an industrious curio collector. Nothing escapes his eye as he packs in bric-a-brac for his nest, which may grow to include several bushels of junk.

Nests have contained such things as old shotgun shells, mousetraps, washbasins, silk socks, bright neckties, candles, soap, dynamite sticks, hen's eggs, and a clipping on forest-fire prevention. One nest contained a bushel of trash, all of which was metal. There was even an alarm clock in the pile.

People who have camped near pack rats in the mountains have had many articles of food disappear each night. Sometimes several rats participate in a raid so that larger items can be hauled off. For example, several rats banded together to roll, push, and drag a large jelly roll out of one tent.

It is hard to say how many fine friendships have been broken by pack rats. One inexperienced camper placed his false teeth beside his sleeping bag when he turned in for the night. When the teeth were gone the next morning, he blamed the guide and gave a heated lecture about practical jokes. The lecture subsided, however, when the guide located the missing teeth amid the loot in a pack-rat nest. The activities of wood rats produced even tenser moments in pioneer days. Cartridges disappeared very mysteriously in dangerous country, leading to no end of dark suspicions and perhaps even tragedy.

Sometimes the rats develop a streak of mischief that might be humorous if they were not so persistent. One little beast continually centered his efforts on the wood-box in an old shack. Each night he would drag the wood out onto the floor and place the pieces in neat rows. This was repeated many times.

Wood rats are also known as trade rats because of their habit of stealing something and then leaving a stick or other worthless object in its place. Many old-timers used to think this trait quite clever and cunning. They thought the pack rat had two reasons for trading: the theft would very likely go undiscovered if the rat substituted another piece of junk; and besides, it showed that trade rats were basically very honest, since they exchanged rather than stole articles.

All this, of course, is sheer foolishness. The pack rat is often carrying a bit of trash for his pile when he chances across an object of even greater esteem. In his greed, he merely drops the first object and picks up the new item. Thus the "trading" habit.

With a home deep in the rock fortress, wood rat, pika, marmot, and callo are safe from most enemies. But some of these mountaineering mammals still fall prey to bobcats, foxes, coyotes, wolves, weasels, martens, hawks, owls, and eagles. The young are especially vulnerable when they innocently wander from the protection of the rocks.

Although wolves or coyotes cannot fit into the average marmot den, they still may catch a marmot out in the open meadows. Sometimes they stealthily stalk their prey and then suddenly pounce and seize it in a strangling jawhold.

Many weasels live in the rockslides and are probably the most important enemy of the pika. Although they can thread through the thin passages between the rocks as fast as the conies, they are sometimes outwitted. As soon as a weasel enters pikaland he is greeted with a barrage of alarm calls; and when he starts pursuit of a choice bit of food, he is indeed in for a race. He dodges in and out among the rocks with unbelievable speed and follows the winding course of the cony with ease and accuracy. The safety of the pika depends on its ability to dodge and outwit the enemy, but the pika soon begins to tire. As the gap between cony and weasel narrows dangerously, another fresh and rested pika leaves its lookout station and cuts into the race ahead of the weasel and just behind the first contestant, who quickly dodges out of the race. When this trick is repeated two or even three times, the weasel shows marked signs of fatigue and gives up the unequal contest.

Continued on page 240

A study in feather arrangement

The Griffon Vulture

By James P. Chapin
Research Associate in African Ornithology, American Museum of Natural History

THE Griffon Vulture (*Gyps fulvus*) is a great soaring bird of the Mediterranean Basin and eastward to central Asia. Because its meals (carrion) must necessarily be few and irregular, it is most economical of energy. Its wings are a model of efficiency. This excellent photograph by John Marinus of Antwerp, Belgium, might be called a lesson in pterylography, the scientific delimitation of feather-producing areas on a bird's skin. You will notice that the black secondaries (the quills of the forearm) are shown in a long regular row at the bottom, where they hide the primaries (the quills of the hand). Next comes the long row of greater secondary coverts. Above them is the row of middle coverts, and above that the great area of lesser coverts, in many rows. Above the wing can be seen the long scapular tract.

A wing like the griffon vulture's is a marvel of aeronautic construction, another of the innumerable examples of natural design to be seen everywhere about us. Anyone who studies birds must be impressed by the way in which almost every feather of any size is of a special shape and structure to serve a definite purpose at its particular location.

One striking feature of the whole plumage of almost every flying bird is the streamlining. Most birds are streamlined right up to the beak. The vultures, however, are exceptional in regard to the head and neck, and the reason is readily seen. If their heads and necks were well feathered like those of their near relatives the eagles, they would have much more difficulty getting their beaks and heads through openings in the tough skin of large, dead mammals to tear out the flesh and viscera on which they feed. The feathering is reduced to a downy cover that permits far greater efficiency in feeding.

A vulture may be called disgusting, but at times it is also majestic. It has its definite place in the economy of nature and usually receives equal protection by law with the songbirds. It is endowed with keen eyesight, most efficient wings, low fuel consumption, and retractable landing gear. It is a worthy member of nature's Department of Sanitation.

The gripping story of how a band of scientific explorers forced the Flaming Terror of the Andes to yield its secrets

PART I

By ROBERT THOMAS MOORE
Associate in Vertebrate Zoology
California Institute of Technology

All photographs by the Moore Expedition

The First Asce

WHEN Edward Whymper in 1880 paused in his descent from the first conquest of Mt. Chimborazo, the giant of the Ecuadorian Andes, he caught sight of a formidable volcano 50 miles to the southeast. The blasé conqueror of the Matterhorn was amazed at the outburst taking place before his eyes. He made drawings of the eruptions, which he presumed were "outrushes of steam," and calculated their velocity to be "twenty-two miles per minute!" Whymper undoubtedly witnessed the early stages of a major eruption, which takes place at periodic intervals ranging from five to fifty years. A decade later, when writing his great classic, *Travels Amongst the Great Andes of the Equator,* he expressed astonishment that a volcano so formidable should be known to Ecuadorians "only by name." Whymper did not seem to know that 34 years earlier Villavicencio had called El Sangay the "most frightful volcano in the World." Nor did his book reveal acquaintance with the observations of non-Ecuadorian scientists and explorers who, for two centuries, had borne testimony to its devastating power.

The first written account of El Sangay is a partially burned document dated November 3, 1628, recently discovered in Ecuador.[1] It describes an eruption of about one month earlier, when the mountain is said to have "burst asunder," "terrorizing" the city of Riobamba 30 miles away and so covering it with ash that its cattle were dying and its inhabitants in dire danger of being destroyed. The next historic reference seems to be that of 1739, when Monsieur de la Condamine witnessed from the paramo of Zula a violent eruption that seemed "to set on fire the whole mountain and its crater," while a "burning river of sulphur and bitumen took its course in the midst of the snowy slopes." An amazing testimony to its energy was given by the geologist Reiss, when he stated that for four years without intermission a stream of incandescent lava flowed from the western shoulder of the

[1]See "El Sangay, Fire-breathing Giant of the Andes" by G. Edward Lewis, *National Geographic* Magazine, January 1950, p. 133, which gives an account of the last unsuccessful attempt to reach the summit.

▼ WHEN CLIMBING out of the tropics, the zoologists leave large trees like these behind at the 10,000-foot level when yet 25 miles from the devastating volcanic cone. Temperate-zone vegetation in the high Valley of Alao, Ecuador

▲ INDIAN PORTERS wending their w
upward with the expedition's cargo
the Valley of the Rio Alao

▲ JUST BEHIND this black wall of lava the Labyrinth begins. Huge ash canyons, 500 to 2000 feet deep, extend for 15 miles from here to the base of the volcano

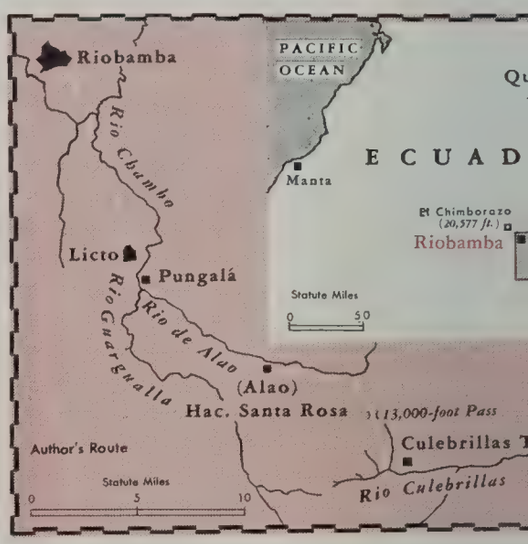
f El Sangay

"THE SHROUD parted for a moment, and there, 70 degrees east of south, El Sangay wered above the labyrinth of canyons." The peak is still many miles away, and network of huge gorges lies between. To save time, the expedition ascended 14,000-foot mountain range to the right to reach a knife-edge ridge before plung- g into the Labyrinth

volcano. In 1849, the engineer Wisse expressed astonishment mathematically by counting 267 loud explosions in an hour.

Many observers have noted that the roarings of the volcano have been heard in Guayaquil, 110 miles across the Andes, and sea captains far out on the Pacific have seen the decks of their vessels drifted with its ashes. So great is the mass ejected, Reclus assures us, that it would equal that of several mountains. "It seems probable," adds Dr. A. H. Mozans, "that the disastrous earthquake which destroyed the old city of Riobamba in 1797 had its origin in El Sangay. So complete and sudden was this visitation that few of the twenty thousand inhabitants were able to escape." And then come the fables and legends that always cling to the skirts of terrifying phenomena. "Everyone

◂ NEAR TRES AGUAS. Here, among the ove hanging grasses of the riverbank, the expe tion discovered the first known nests of t Black-throated Bronze-tailed Hummingbi Like all of the more than 600 other speci and subspecies of hummingbirds, it lays tv pure white eggs. Tracks of the rare Mounta Tapir marked the muddy approaches to t stream



had heard of the 'Flaming Terror to the east of the Andes,'" said Commander Dyott, "but no one had ever ventured near it. Within several leagues of its base (so ran the tale) were lakes whose water spouted high in the air, drenching the country for miles around and forming a sort of water barrage." And even the renowned Humboldt did not dissolve this atmosphere of superstition by describing a fish, "*Pimelodus cyclopum*," which he says was thrown out in great numbers during minor eruptions of Cotopaxi, Tungurahua, and Sangay!

I have not space to quote from Wolf, Stübel, Hans Meyer, Stevenson, and many others who have observed the demonstrations of El Sangay. A final quotation from the *El Telegrafo* of Guayaquil will suffice: "Alfonso Stübel . . . initiated an attempt to creep up on the shoulders of the colossus in April of 1872, but he, like G. M. Dyott, the intrepid Andean explorer, abandoned the enterprise, their audacity punished by the imminence of destruction."

There seems to be no record that anyone actually crossed the snow line until November, 1925, when Commander Dyott, after months of effort, came to grips with the ice field.[2] On his first attempt he was struck down with snow blindness, and on his second he fell into a crevasse on the southern shoulder, while his companion was incapacitated by mountain sickness. Both finally abandoned the effort. *El Telegrafo* concludes, "El Sangay continued to guard its mystery inviolate—a mystery vast and sublime!"

As I survey this strange admixture of science and superstition, I do not wonder why so many efforts have been abandoned at the far-flung boundaries of El Sangay's demesne. I confess I was affected. No doubt it influenced my statement to members of the party, "This first attempt is purely a zoological reconnaissance to Culebrillas Valley, only three days' journey! There is not one chance in fifty I shall give permission for an assault on El Sangay." And yet I did!

Mysterious as it all seemed, one thing was clear—the terrain would prove a difficult problem. Detached from the main chain of the eastern Andes, El Sangay juts out over the Amazon basin, a lonely sentinel nearly 18,000 feet in altitude. Although only 125 miles south of the equator, its last half mile of altitude is crowned with ice. At its eastern base begins the tropical forest which stretches without break 3000 miles to the Atlantic. So impenetrable are the jungles of the steep eastern slope that no one has attacked the summit from this direction. On the other three sides, 1000 square miles of volcanic ash have been sculptured by almost constant rains into a labyrinth of black canyons 500 to 2000 feet deep. Down each one swirls an angry torrent—the whole constituting a veritable maze, whose intricacies have never been deeply penetrated by the superstitious Indians living about its margins. They never cross its borders save for an occasional forage among the rare animals, which here have made their last stand in a sanctuary created by superstition. Above and about it all hangs a shroud of mist and cloud, lifted but for brief intervals.

In addition to difficult terrain, severe weather conditions, and the possibility of a major eruption, the superstitious fears of the native cargo bearers constitute an even more serious impediment to would-be conquerors of El Sangay. Favored by no trails to slip through the tough undergrowth and surmount the great ranges, one must rely upon these natives to carry most of the supplies and equipment required for a month's struggle with unexplored regions. They believe that a frightful god lurks in the crater, who waits for them to enter the canyons and drowns them with floods of water and ice. Terrified by the frequent earth-vibrations emanating from the great volcano, they are ready to forsake the explorer the moment the peak appears

[2]See "The Volcanoes of Ecuador" by G. M. Dyott, *National Geographic* Magazine, Jan., 1929; also his book *On the Trail of the Unknown*.

through a rift of the shroud. Three times our party was abandoned by different groups or individuals, the mass desertion at Tres Aguas threatening disaster. With tents leaking, ammunition and food supplies wet, and fires refusing to catch flame, the party was in real danger, either of being washed out by rains or weakened by lack of food. Fortunate kills of deer and tapir relieved the tension.

On July 15, the party, consisting of Lewis Thorne of Yale University, my son Terris Moore[3] of Williams College, Waddell Austin of the University of California, and three Quechua zoological collectors, with myself as leader, motored out of Riobamba, Ecuador. We soon found ourselves in a public square of the Indian village of Licto. Here our genial host, Señor Alphonse Merino, on whose courtesies and thoughtfulness the success of our enterprise largely depended, introduced us to our caravan of eight horses and ten pack mules. After the usual delay (according to approved Ecuadorian style), we mounted and shot through space like arrows loosed from a bow, and for three hours we careened along the Rio Alao at the same mad pace, whether the course clung to the brink of gorges, or dropped down descents strewn with boulders, or slipped through cascades loosed from the mountain above.

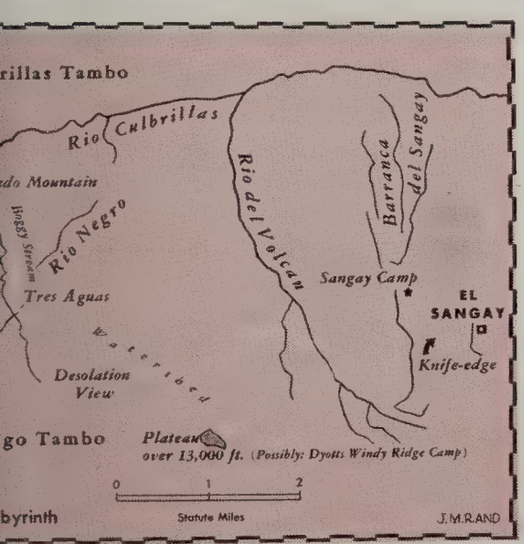
At Hacienda Santa Rosa, which we called "Alao" after the river, Señor Merino had a surprise for us. Through the motley mass of peons in the courtyard we were escorted into a bedroom furnished in the style of Louis XV! The leader of the party was only too glad to accept the offer of the gilded bed, for he had risen that morning with a temperature of 103 degrees. The rest of the party were shown the premises. Señor Merino explained his plans for gardens and fountains to be modeled after a famous French chateau. Electric fixtures and water pipes had been installed, although not yet functioning, and a library revealed interesting titles in Spanish and English. The buildings were the center of a ranch whose borders stretched in a vague way from the ice fields of El Altar to the affluents of the Amazon. Over this vast demesne our host reigned, a medieval lord with a retinue of peons at command. They could not leave his property without consent. His approval was asked for marriages, and punishments for misdeeds were assessed by him as judge. He had the right to use the lash.

Somewhere in this realm rose El Sangay, but the owner had never seen it, and his brother Miguel, who had, was now dead. Yes, he knew of Señor Dyott's attempt to reach the summit. Two of the peons who had gone part way with him were left; one of them—Vinci—would be our guide. "But," he added emphatically, "this is a bad time of the year to try El Sangay—the very worst! It rains every day for months! The Indians fear the rising streams!"

Nevertheless, the following morning our equipment of tents and blankets, guns and traps, cameras, color plates and films, and all the paraphernalia for mountain ascents (ice tent and optimus stove—even snowshoes and an ice ax) were packed on the backs of eleven Indians, and off they dog-trotted up the valley. Flowers were grouped in great clumps along the stream that leaped from rock to rock. Calceolarias proffered clusters of golden slippers, Taxcus climbed here and there through the thick growth, their great pink trumpets nodding overhead. Large patches of the orange parasite called "Picapus" brought beauty to the treetops and lured the Sunbeams—hummingbirds, *Aglaeactis cupripennis cupripennis* Bourcier, with a veritable sunset on their backs. But the glory of the valley was the fuchsia. The superb scarlet bells hung in every conceivable line of grace and tempted hummingbirds of many species to explore their chalices. On all this loveliness of flower and dashing water, a tropical sun shone with a balmy intensity found only in favored Andean valleys.

But beauty and sunlight had to be

[3]Subsequently Terris Moore made the first ascents of Mt. Bona and Mt. Fairweather in Alaska and still later of the 24,900-foot Minya Konka of western China.



▶ ON THE EDGE of a 2000-foot cliff, the newly recruited Indians are transporting the expedition along the knife-edge between Tres Aguas and Carniceria. The knife-edge has begun to widen out, and the Indians are gazing into the vast maze of ash canyons, only a small portion of which can be seen here

◄ THE MARGIN of the plateau called Carniceria ("Meat Market") by the Indians. The paja grass, with rapier-like edges, grew five to eight feet tall in the center of the plateau. Herran's Thorn-bill flitted among the flowers of the pear-like tree—its fiery throat a fit symbol of the mighty volcano

left behind when we began the steep ascent of the southern rim of the valley. For a while sunlit glimpses of Alao could be caught through heavy tree growth clinging to the lower walls, but shortly thereafter we reached the wind-swept paramo and under the wings of inquisitive condors began our long trek beneath the pall of cloud and mist, which we came to call "The Shroud of Sangay." From this time on, rain fell every day for the next 26, with only occasional parting of cloud masses. Sometimes it drenched us with sudden outbursts, sometimes it swathed us in chill mist, but for the most part it contented itself with a monotonous drip, drip, drip—day after day—that gradually sapped ambition and made memory of sunnier hours seem like dim-remembered childish pleasures. When sunlight finally came, all semblance of a trail had disappeared. Our first camp was pitched at the top of a high pass to the accompaniment of bleak winds and the howling of many dogs. The Indians insisted on taking these ravenous creatures to help in hunting tapir and deer.

For several days we followed the general course pursued by Commander Dyott over three mountain ranges. Because of deserting Indians and other difficulties, few days registered progress. Throughout this period we occasionally happened on machete marks on shrub or tree, where Dyott may have passed. After the thirteenth day we descended into deep canyons and never came across any marks again. It is impossible within the limits of this article to tell the many incidents and near-disasters of these difficult days. Kaleidoscopic views are the best I can attempt.

Toward the end of a day of constant climbing, we reached the top of a pass 13,000 feet above the sea. The wind howled through the gap at a temperature close to freezing and drove us down the opposite slope for protection. Trails there were none, except the bed of a stream. For hours we stumbled and slipped over hummocks of *paja* grass, forever stubbing our toes and dropping into concealed gullies. We were thoroughly soaked. Wading the icy torrent seemed preferable to the pounding that toes and ankles were taking. The earth assumed the consistency of a supercharged sponge. We forded many streams. As the light darkened and the billowing Shroud sagged into the valley, we located the remains of Commander Dyott's camp site at Culebrillas. We pitched our tents in the driest spot of a huge morass that filled the entire floor of the valley. That same night fortune favored us. The Shroud parted for a moment, and there, 70 degrees east of south, El Sangay towered above the labyrinth of canyons. Incredibly high it stood against the southern sky, ghostly and wan in a flood of moonlight. It seemed to fill the whole end of the valley, and yet it must have been many miles away. But distance conveyed no feeling of safety when that night a severe earthquake brought us to our feet!

We had now reached the margin of the tangled mass of canyons. The front of a lava flow faced us. Our valley ran approximately southeast directly toward El Sangay, and not far away in that direction began the intricate system of water-sculptured chasms, which we termed the "Labyrinth." If we wanted to proceed into it, a route straight down the valley would mean nothing but an endless crossing of canyon after canyon. The valley wall on the southern side headed in the desired direction. We named it Dorado Mountain for the rare hummingbird we found there. It was decided that Lewis and Terris should follow the top of its ridge in order to ascertain whether it continued for any distance and might afford easier access to El Sangay.

Here Vinci, the leader of the peons, refused to go with them. He claimed rheumatism! We suspected cowardice. He even refused to let his peons advance without him, exclaiming, "There are no trails! We have to cut through with machetes!" A threat of punishment from his master, Señor Merino, brought him to terms. His sullen look as he left indicated no desire to co-operate.

As we watched the boys lightly plunge up to their waists into the Rio Culebrillas, the rest of us gave attention to the exploration of Culebrillas Valley. No zoologist had ever set foot in it, let alone entered the Labyrinth. The entire floor, 11,000 feet in altitude, consisted of a vast water-soaked swamp of paja, ex-

➤ A DOZEN PHOTOGRAPHS would be necessary to give a complete panorama of the Labyrinth from Desolation View. The entire area was once a huge plateau of black ash vomited out of El Sangay. Now it is sculptured into a network of gorges

cept at the southeast end, where it was broken by the black front of a lava flow that had its origin in El Sangay. A stunted tree growth covered the lower slopes of the mountain walls, and their gnarled condition reflected the severe climate. Small waterfalls dropped here and there, attracting a few insects which, in turn, lured five kinds of hummingbirds to the valley. All told, eight species of these iridescent creatures were found in the larger Sangay area, an astonishing number in view of its barren volcanic nature, relieved only by grass and stunted trees and practically barren of flowers.

The most conspicuous hummingbird was the huge Sapphirewing, *Pterophanes cyanopterus cyanopterus* (Fraser), whose ultramarine wings flashed back and forth through the sunlit spray of the waterfalls. It created a lasting memory of color and grace in motion. Gay's Velvetbreast, *Lafresnaya lafresnaya saül* (Bourcier & Mulsant), with its glittering black apron, fed from the orange corollas of a parasite, which festooned the moss-covered trees. The most persistent sound was the loud call of the Mountain Ant Thrush, *Grallaria monticola* Lafresnaye. Heard, but seldom seen, this bird dashed about the boggy runways. When calling, it stretched its stiltlike legs to full limit and then collapsed like a jack-in-the-box.

The most conspicuous sight in the valley were the hurtling forms of Noble Snipe, *Capella nobilis* Sclater, closely resembling our own Wilson. At twilight the ecstatic gyrations of the rarer Jameson's Snipe, *Chubbia jamesoni* (Bonaparte), whirled overhead to the accompaniment of strange sounds like a policeman's rattle of varying pitches. There were Tinamous on the paramos, Spur-winged Ducks in the streams and Red-backed Buteos[4] on the dead trees, occasionally tearing a rabbit to pieces for a clamoring youngster.

But our supreme moment of scientific excitement came with the songs of Tanagers. At the southeastern end of the valley, the Rio Culebrillas wound across to the north side along the lava flow and cut its way through to the first deep canyon of the Labyrinth. Here tree growth was heavier. Singing in the treetops was an extremely beautiful bird, brilliant in green, yellow, blue, and black. It proved to be an undescribed race of the Blue-rumped Mountain Tanager, *Buthraupis eximia cyanocalyptra Moore.* Still more startling was the discovery of a golden tanager with sky-blue wing marks, so different from all other tanagers that a new genus had to be created for it by the author. He subsequently gave to the American Museum one of the only three known specimens of this bird, *Tephrophilus wetmorei* Moore.

In other ways we were well rewarded, in spite of continuous rains. We secured many small mammals and 223 birdskins, discovered the nests new to science of several species, procured the second specimen in existence of a rare white-tailed deer, and found in the heart of the Labyrinth the unknown home of the nearly extinct Mountain Tapir.

On the third day, Terris and Lewis returned with an alluring account of the volcano that stood stark and gaunt on the skeletonic ribs of the Labyrinth and of a lofty watershed bisecting it, which proffered an opportunity to climb over its canyons. But while we discussed the possibilities, we were faced with a serious loss in personnel. Old Carlos Olalla, for 40 years triumphant victor over the wildernesses of Ecuador, had to admit defeat. Without his sage counsel and ability to understand and control the waywardness of the Alao aborigines, we would be badly handicapped.

On the following day, leaving all heavy equipment with Carlos at Culebrillas, the main party crossed Mt. Dorado to the south at an approximate elevation of 14,000 feet, laboriously cutting a way through the gnarled tree growth, and plunged into the wilderness on the other side of the range. My notes remark: We followed a stream down its boggy course, slipping in countless mudholes. Late in the afternoon we reached the junction of three rivers completely "bogged," as the boys expressed it. A mile from our camping place we passed by the water-soaked cliff where Terris on the reconnaissance had discovered the first recorded nest of the Fiery-throated Hummingbird, *Chalcostig-*

Continued on page 238

[4] *Nothoprocta curvirostris* Scl. & Salv., *Merganetta armata leucogenis* (Tschudi), and *Buteo polyosoma polyosoma* (Quoy and Gaim).

Leonhardt photo from Black Star

▲ ANIMAL OR VEGETABLE? Not a tobacco leaf with legs and feelers but a South African long-horned grasshopper, *Cycloptera camillifolia,* neatly camouflaged from preying birds and reptiles

Leonhardt photo from Black Star

▲ IS THIS a withered twig stuck against the bark? Its odd-shaped thorny "leaves" blend with the background, but it is one of the insects known as the phasmids, *Extatosoma tiaratum.* It is found (by those whose eyes are sharp enough to see it) in New Guinea and Australia

HOAX or Fair Warning

Many unarmed creatures have bought security the cheap way—masquerading as animals that are dangerous or as unattractive parts of their natural background

By LORUS J. *and* MARGERY J. MILNE

EVERY summer, by way of showing a few outdoorsmen the importance of a wide familiarity with animals, we point to a golden-brown insect hovering over a flower or busily seeking nectar within the blossom, and ask: "What is it?"

Our friends look at us with amazement. How can we be so ignorant? "A bee!" they almost shout.

We prod it with a finger, and it buzzes but keeps on feeding. "Don't do that. You'll get stung!" someone is sure to warn us.

By way of answer, we swoop down on the insect with open palm and snatch it from the flower into a clenched fist. Instantly the buzz rises to an angry whine. While our friends watch apprehensively, we reach in with thumb and forefinger and casually pluck out the struggler by its wings. The insect's abdomen prods around toward us as though ready to drive home a vicious sting. But nothing happens. The "bee" is a fly—the Drone Fly—an impostor that has fooled many people, as well as millions of hungry birds. It is completely defenseless but so like a honeybee in shape, size, color, and antics that a practiced eye is needed to detect the difference.

Nature is full of pretenders. Wherever we and the other animals learn by experience to expect one situation, some few creatures profit by our expectation and thereby prolong their own lives. Some creatures are strong, well armed, and ready to resist attack. Others, lacking such advantages, escape because they *seem* to be what they are not. Imitators of this sort are common all around us, but care is required to hunt them out.

A wide variety of animals evade notice because they resemble plant parts. Creeping over seaweed are shell-less snails, camouflaged by all manner of waving, leaflike appendages in a great range of colors. They are known as Nudibranchs, and they often miss detection because the gentle waving of their decorations, in time with strands of seaweed, conceals their leisurely progress from place to place. Sargasso Fish are equally difficult to recognize in their tropical and subtropical waters because of their simulation of seaweed.

Among land animals, the insects are the chief imitators of vegetation. Almost everyone has heard of the Leaf Butterfly of India (*Kallima*), in which the closed wings resemble a leaf, complete with midrib, short petiole, and some indications of branching veins. In temperate America we have other butterflies that suggest leaves, but our kinds all possess what appear to be tattered edges, as though the leaf were not only a dead one but had been lacerated by wind and winter. Sev-

eral of these ragged-wing butterflies follow a seasonal cycle that gives their resemblance to dried leaves more than coincidental significance and more than incidental value. They are active chiefly in late autumn and early spring, when green leaves are rare. They have only to cling to a branch and close their wings to disappear. In winter, they conceal themselves as adults under bark or in crevices.

A bare stick may attract even less attention than a ragged leaf. Resting among twigs, our native Stick Insects are almost perfectly concealed, and their movements when undisturbed are so slow that the illusion is seldom destroyed. Nor do most of them descend to the ground to lay their eggs. Instead they drop them, like so many radish seeds, to bounce from leaf to leaf. They patter like rain when the insects themselves are numerous, to lie among the fallen foliage through the winter. In the spring, each pale-green stick insect emerges by a private trap door in its seedlike egg.

In the tropics, stick insects grow to larger sizes, and many of them are winged. Some have leaflike ex-

A STICK INSECT has a silhouette like a up of twigs. As long as it moves slowly, nay easily be passed unnoticed

Photo by Lorus J. and Margery J. Milne

Photo by Lorus J. and Margery J. Milne

▲ THE PRAYING MANTIS matches foliage so well that it easily ambushes flies, moths, and caterpillars

tensions on legs and body that look like the remains of foliage after an army of caterpillars has hurried through. Grasshoppers, too (particularly the long-horned kinds related to our katydids), show comparable diversity. Removed from their leafy homes, these green insects are seen to be ornamented by the most fanciful projections, as though each were but a caricature of a grasshopper. They are as unnecessarily decorated as a billboard embellished by crayon-wielding small boys; but Nature has not burdened them with useless impediments. These decorations help the insect to survive by blending the leaflike body with the tropical foliage.

Similarity to plant parts can also help the hunter as well as the hunted. Praying Mantises of many kinds wait hidden by the leaves, among which they stand motionless or sway gently from side to side as though tossed by a slight breeze. Such deception in the tropics may be augmented by tattered appendages of leafy green. Then along comes a fly, a beetle, or a caterpillar. The mantis' triangular head turns big eyes toward the prospective victim. Suddenly the folded forelegs extend from concealment

Leonhardt photo from Black Star

▲ APTLY NAMED the "Devil's-Flower," this mantis of Africa conceals itself effectively among the vegetation and is a hidden trap for other insects. (*Idolum diabolicum*)

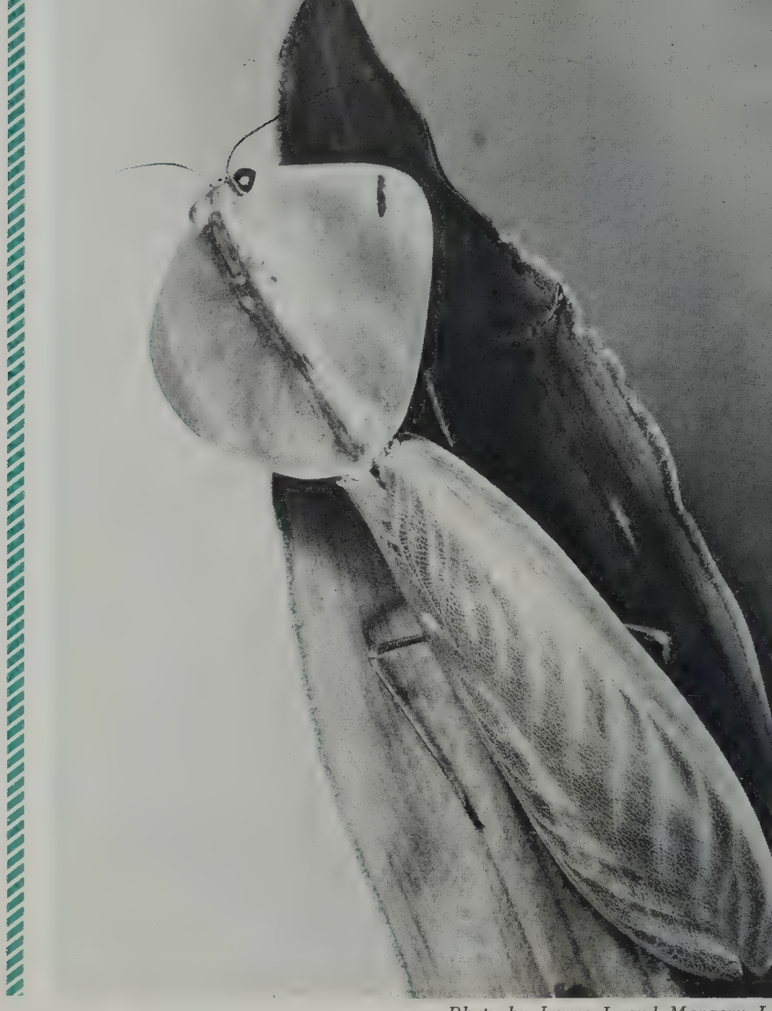


Photo by Lorus J. and Margery J.

▲ A PRAYING MANTIS from Panama. In additio green coloration, it has leaflike extensions from its that heighten the illusion

and as quickly return, with the prey clutched between. Sharp teeth on the inner surfaces of the legs provide a grip as inescapable as the spikes that lined the Iron Maiden of medieval torture chambers. The mantis is an insect trap, and its ambush technique is aided by the creature's resemblance to harmless herbage.

Much of this imposture depends upon the mantis standing still. The caterpillar that approaches may be a brown inchworm, measuring its path in a characteristic looping gait. If the mantis is so hungry that it moves toward the larva, the latter may recognize approaching doom or feel the quiver of a twig—warning enough to induce the caterpillar to use its own concealment. The inchworm may then cling to the branch with its hinder pairs of legs, while letting go with the front set of six and extending its cylindrical body as though it were a mere leafless branch, forking from the stem at an angle of some 60 degrees. As long as it retains this pose, the mantis is unlikely to attack. If the patience of the hungry mantis is less than the seeming trance of the sticklike inchworm, the bigger insect may move off and the caterpillar survive to become a flying moth with angular wings. Instinctive actions and protective appearance go hand in hand if survival value is to be achieved.

Certain birds make life precarious for many insects. But a few of the true bugs, called Tree Hoppers (or more imaginatively, "Insect Brownies"), have an extraordinary projection from their armored backs, which causes them to look like a thorn or bur. Sometimes the hopper comes to rest with the thorn pointing in the wrong way, but few birds are good enough botanists to quibble over this detail.

In evaluating protective resemblances, it is always most important to bear in mind that man's vivid imagination may suggest similarities that have no significance in terms of survival. The habits of the animal must always be taken into full account. Thus for any of our long-horned grasshoppers to escape capture by resembling green leaves, the insect must remain silent and motionless, for the most part, all day long. It can become active only after the sun has set, when most insect-hunting birds are asleep. And when the long-horns go flying through the night air, as they often do, their protective resemblance is of no avail. Some owls catch them in remarkable numbers.

Resemblance to foliage and plant parts by no means exhausts the possibilities of protective body form. Several caterpillars and a few moths spread out on leaves in an irregular mound of mottled colors that simulate closely a bird dropping splashed on the vegetation. As long as these insects remain motionless, they may be missed repeatedly by hungry birds. Similarly the many leaf beetles that have short, cylindrical bodies with irregular upper surfaces appear to be fecal pellets of caterpillars rather than objects that might contain nourishment for a bird. If disturbed, most of them retract their

Leonhardt photo from Black Star

WHEN IS A THORN not a thorn? When it certain Central or South American tree pper, *Umbonia crassicornis*

legs and antennae into protective grooves and tumble to the ground, out of danger. Under the microscope, these beetles are beautiful—with iridescent, sculptured bodies that reflect the light. But on a leaf, with no more magnification than a bird's eye gives, their imitation of waste material is remarkably convincing.

Sometimes it is difficult to explain the strange appearance of animals by anything but coincidence. A Lantern Fly of the American tropics (*Laternaria* sp.) has an enormously enlarged, hollow projection from its head. This extension, if viewed through a hand lens, is astonishingly like an alligator's head—with protruding "eyes" above, a snout, and a long mark on each side that is decidedly similar to the elongated mouth and exposed teeth of the reptile. But what bird that fears alligators goes around with a hand lens, to be frightened by this apparition? Early explorers brought back specimens of this fairly common insect and also tall tales of how

Photo by Lorus J. and Margery J. Milne

▲ THIS COMMON LONG-HORNED GRASSHOPPER of New England matches its background of foliage so well that the naturalist may have to search closely to find it: another example of resemblance having survival value

Photo by John C. Pallister

▲ IF SUFFICIENTLY ENLARGED, the fore-part of a lantern fly reminds us of an alligator's head. But it is doubtful that any of the insect's enemies would be frightened away by such a comparison. This seven-inch specimen from Peru, though large for an insect, is far below the dimensions of an alligator

▼ A WEST AFRICAN long-horned grasshopper that simulates a withered leaf: the masquerader known as *Acridoxena hewaniana*

Leonhardt photo from Black Star

its head glowed like a lantern in the dark—hence the name "lantern fly." All large museums receive examples each year, sent in as "rarities." The luminescent story has not received verification. And so far, no one has produced an adequate explanation for the extraordinary development of the lightless lantern fly's head.

Sometimes it is difficult to imagine why a certain insect is avoided by an animal. A number of Ghost Crabs (*Ocypode*) that shared the authors' apartment one summer were tested repeatedly with freshly caught insects for food. All were highly acceptable—except fireflies. These were either rejected or ripped apart and then thrown away. Yet toads sometimes eat enough fireflies to turn them into animated lanterns, the unquenched lights shining through the stomach wall.

Many animals learn what may be eaten and what may not by trial-and-error methods. A bird clearly develops a tendency to avoid a hornet or a stinging caterpillar after a single try has proved distressing. The insect eater learns to distinguish the objectionable prey (and anything resembling it) as thoroughly unsuitable for food.

An insect that is avoided because it is recognized as an unpalatable, malodorous, poisonous, stinging, or biting creature does not need camouflage. In fact, bold coloration with a maximum of contrast would help to advertise its presence. Sure enough, skunks are plainly marked in black and white—the utmost of contrast—and they walk about so deliberately, fearing no attack, avoiding no enemy, that motorists and locomotives run them down by the score. Yellow and black Zebra Butterflies, and others of the heliconiids which are known to be distasteful to monkeys and birds, are vividly banded. Young animals will try one heliconiid butterfly but not a second. Like the skunks, these insects bear clear warning patterns and can afford to be most deliberate in their movements.

The many kinds of bees and wasps resemble each other more in color and pattern than would be expected in so large a group. But as Fritz Mueller pointed out in the middle of the last century, stinging insects enjoy a distinct advantage if they have a general similarity in appearance. If each kind of stinging bee and wasp had a different appearance, a much larger number of individuals would be killed in educating each bird than if a lesson learned from one experience could apply to many. Hence, evolution seems to have favored the development of similarity among these well-armed insects.

A badge of immunity may be counterfeited. The drone fly, so like the honeybee, demonstrates how freedom from attack may be achieved by a lamb that wears wolf's clothing. The closer the resemblance, the fewer times a drone fly is eaten by a bird. The flies frequent the same flowers as the bees and mimic them wonderfully well. Even the robber flies that attack honeybees to suck out the contents of the honey-gatherer, using a technique that protects them from being stung, follow the same procedure with the drone flies, which could not sting if they wanted to. The carcasses of both insects often accumulate under a favorite perch of the hairy, predatory flies—as a cemetery of empty shells, mimic mixed with model.

The drone fly belongs to a celebrated group of aerial acrobats with perfect wing control—the Hover Flies. They are members of the family Syrphidae. Many of this great group of interesting insects mimic the bees and wasps in body form, pattern, and habits. Some are slender like hornets, others robust like bumblebees. A few of them use their disguise to enter undetected into the nesting areas of the more industrious bees in order to rob them of their food stores or lay eggs that will hatch to maggots and fatten at the bees' expense.

Even beetles mimic bees, particularly bumblebees, and frequent flowers. The so-called Bumblebee Flower Beetle (*Euphoria*) is often seen in spring, flying a few inches above the ground in nicely controlled flight, entering among canes and other low-growing vegetation, humming very much as does a home-hunting bumblebee. In the South, the Figeater is another scarab that is easily mistaken for a bumblebee as it visits flowers and

▼ Bumblebee hawk moths quickly lose their dark wing-scales after emerging f the pupa at upper right. Then, with clear wings (*lower right*), they flit from flowe flower like a bee and enjoy the protection of a sting they do not possess

Photo by Lorus J. and Margery J. M

ripe fruits. The curled, white, grub-like young of these insects feed upon roots, however, and the parents make no known use of their similarity to bees except as it frees them from attack by birds.

A few moths that are active by day are readily mistaken for stinging insects. The Bumblebee Hawk Moths emerge from their pupal shelters in the earth with a full covering of overlapping scales on their wings, just like those worn by others of the Sphinx group. But most of the scales fall off as soon as the wings are used, and before long the insect is as clear-winged as a bee. Even the antennae are shorter, blacker, and more clubbed, as though in imitation of the prominent elbowed antennae of the armed insect. Clearwing moths of the more slender aegeriids have a closer resemblance to wasps and are active on the same flowers at the same time of year. Presumably they enjoy freedom from molestation by virtue of the "pointed arguments" the stinging models carry.

Ants, too, have their mimics. Some longicorn beetles and several true bugs resemble ants in markings, body dimensions, and manner of walking. But an assortment of insects from various groups actually associate themselves with ants, acquire the odor of the anthill, and roam about freely within it. They feed on the stores of food that the ants accumulate and even beg drops of regurgitated nourishment from their passing hosts. These "guests," properly called inquilines, form a most interesting addition to the anthill population. There can be no question but that their similarities benefit the mimics.

If it is to profit by the disguise, a defenseless animal that resembles an armed one must always frequent the same places as the model, at the same time of day and year. The Leaf Fish, *Lobotes surinamensis*, is an interesting case in point. The young of this fish closely resemble the floating dead leaves of the red and black mangrove among whose leaves they make their home. And when a handful of the leaves was tossed into an aquarium containing one of these fish, it immediately moved toward them and literally "schooled" with the leaves. It lives on its side near the surface, with its body curved downward in a slight arc and often with its head slightly lower than its tail. It moves lazily through the water by means of transparent pectoral fins, so that there is no appearance of muscular activity. The fish is yellowish-tan, marked with brownish-black spots, and it reaches the right size at just the right time. In summer, the leaves are bright green, but in the autumn, when most of them fall, they turn yellowish and finally brown or nearly black. The fish apparently reaches the right size to enjoy protection when the leaves themselves have come to resemble the fish most closely.

It was Henry W. Bates, an explorer of the Amazon basin a century ago, who first pointed out that harmless and dangerous creatures are sometimes encountered in the same region and in a similar guise. This sort of mimicry has been called Batesian mimicry ever since. We see an example in the harmless Harlequin Snake, which lives in the same territory as the poisonous Coral Snake. Though unrelated, it has the same alternating bands of scarlet, black, and yellow—though in a different pattern. If one does not memorize how the colors alternate, it may not be easy to tell the poisonous snake from the harmless one on

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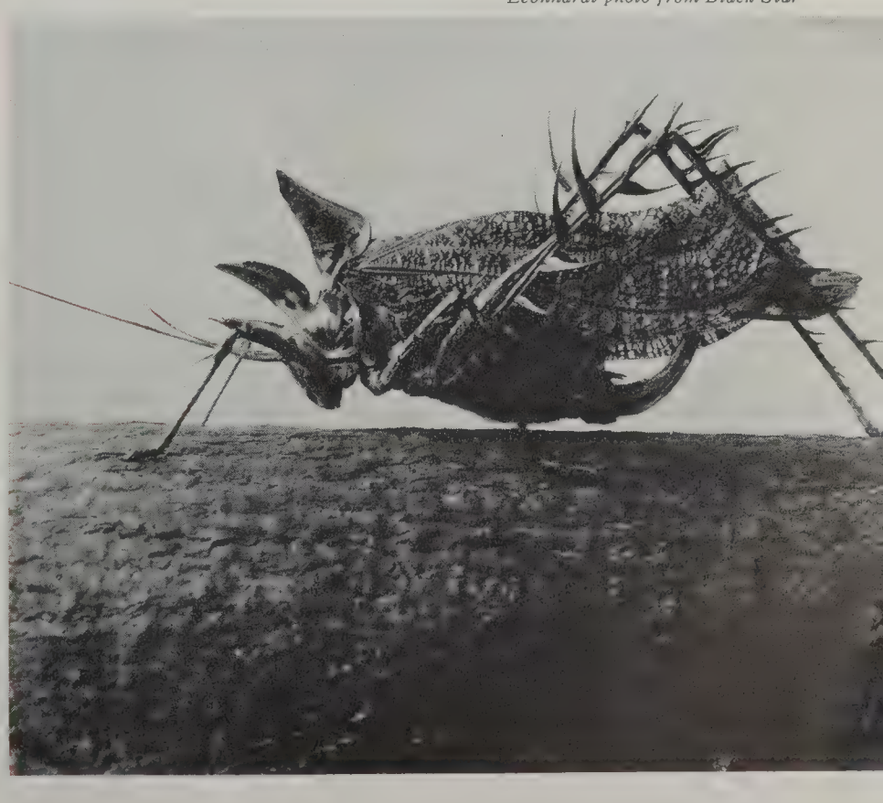
FLY that looks like a wasp. The Soldier Fly has n-yellow bands arranged like those of the wasps frequent the same flowers. It also has conspicu-ntennae that are elbowed like those of the sting-ees and wasps

Photo by Lorus J. and Margery J. Milne

▼ A GROTESQUE EXAMPLE of leaflike mimicry: a long-horned grasshopper (*Markia hystrix*) from Panama, Colombia and Brazil

Leonhardt photo from Black Star



New Mexico State Tourist Bureau

THE *Great White Sands*

Our most extraordinary desert beckons those who seek the truly bizarre—a curious assemblage of persevering plants and ghostlike animals struggling amid a snowy sea of dunes

By NELL MURBARGER

MICE and lizards of snowy whiteness, yuccas with stems 40 feet long, sand that isn't sand, lakes of crimson water—these are some of the tales that are told of New Mexico's Great White Sands. Thrice difficult is it to winnow the wheat from the chaff—to declare with certainty, "This is fact" or "This is fable." Chiefly this is so because there is still much unknown about this strangest and most spectacular of our deserts—this 176,000-acre wilderness that looks like a stage setting of the Sahara done in granulated sugar.

These undulating white dunes extend across more than 200 square miles of territory and bear no relationship to silica or quartz sand, being composed of 99 per cent pure gypsum crystals and 1 per cent quartz and other impurities. They were already known to Spanish explorers when Virginia was still a struggling colony of the Crown.

When pioneers first settled in the Tularosa Basin, in what is now south-central New Mexico, they felt only hatred and distrust for these ever-shifting hills, fearing that the dunes would eventually swallow homes and ranches, even the growing settlements. Yet even as they feared the spectacular white sea, these early settlers found themselves drawn irresistibly toward it; and whenever time and Indian troubles permitted, they packed lunch hampers and journeyed by horse and buggy to "The Sands," there to spend a day picnicking and playing.

Closer acquaintance saw the earlier dread replaced by a feeling of friendliness, and as the population increased roundabout, the sands became a popular site for

RICA'S "LITTLE SAHARA" covers
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church suppers, lodge gatherings, Sunday School picnics, Easter Egg hunts, weiner roasts, school playdays, and moonlight frolics. But all these visits were strictly marginal affairs, and until fairly recent times the heart of the Great White Sands remained virtually as little known as the Gobi. Not only was it a land completely devoid of surface water, said local legend, but it was a place where no form of life existed—plant, animal, or insect—a gleaming wasteland, as barren as the arctic and as hazard-fraught.

In these same White Sands, however, people of the Tularosa Basin realized that they had a scenic wonderland unlike any found elsewhere, and about 1922 they began a decade-long fight to set aside a portion of the area as a National Park or Monument. The late Tom Charles, then Secretary of the Alamogordo Chamber of Commerce, was named Chairman of a special White Sands Committee. Year after year, Charles made the Sands project his special baby, working either alone or in co-operation with Sands-minded officials of other communities as far distant as El Paso.

While Secretary of the Interior A. B. Fall and New Mexico's U. S. Senator Bronson Cutting were both giving the issue their wholehearted backing, there was the usual opposition from enemies of conservation. At last, about 1929, a government representative was sent to appraise the merits of the place. Arriving there he found a region whose fringes had been overrun by picnickers for two generations, while its interior, so far as he could learn, had been seen by no man except from a distance!

It was Tom Charles, naturally, who accompanied the official party in the capacity of guide and general trouble shooter. The "invasion" was no sinecure; not even a wagon trail had ever been built into the region. From the south and west, entry is precluded by the several thousand-acre expanse of swampy Lake Lucero, while from the north or east the steep lee sides of the dunes present a formidable appearance. It is impossible for a vehicle to climb the leeward faces, but the flats between are firm, and it is possible to follow a zig-zag course.

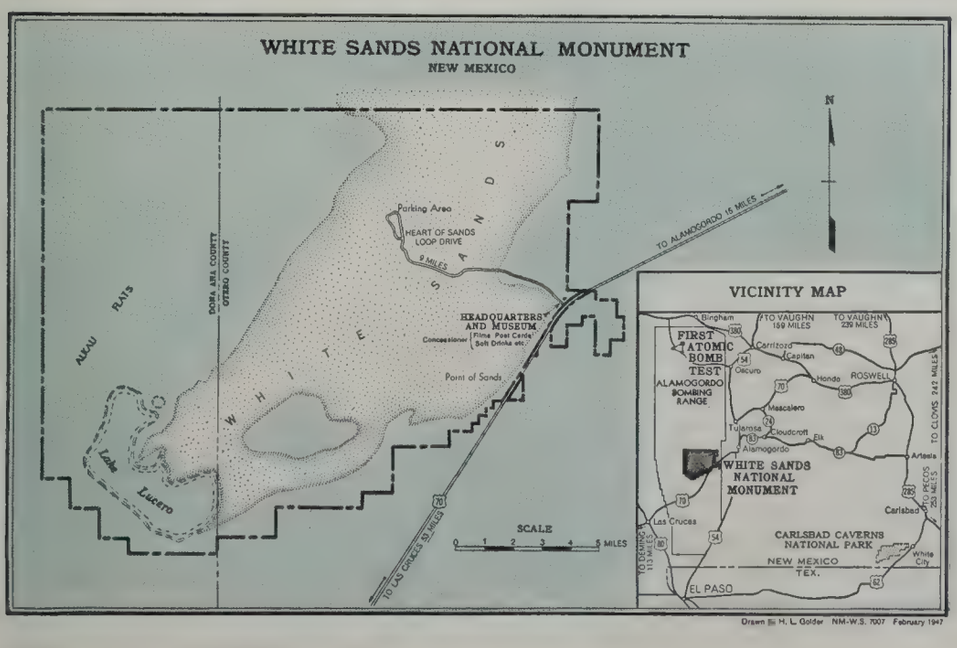
"After four and one-half hours . . . of shoveling down the sandhills and throwing in scattered stalks of yucca to make the road passable," wrote Mr. Charles in his description of that initial inspection tour, "we arrived at a point where we were satisfied that we were in the Sands proper."*

By the time this exploratory journey was completed, Uncle Sam's representative was fully convinced that this was one of nature's true marvels—an area unlike anything else in the world and certainly a place worthy of recognition as a National Monument.

Others, unfortunately, held quite

Western Ways photo by Ray J. Manley

▲ THE TRACKS of yesterday are erased tomorrow in the dunes of the Great White Sands. But troublesome sandstorms occur only when the wind is very high



New Mexico Magazine, July, 1932.

Photo by Hubert A. Lowman

▲ WHERE THE WIND endlessly writes its autograph: a brilliant world of curves and timeless change. Some of the dunes are 50 feet high

different views. While this great white desert had lain unused longer than any man knew, commercial interests rose in alarm as soon as it was under serious consideration as a park reserve. As one of the world's largest gypsum deposits, they declared, here was potential revenue far too great to be "wasted" on recreation alone. They cited the staggering value of the Sands for fireproofing material, for wallboard and tile, wall plaster and exterior stucco; as plaster of Paris and casting plaster for surgeons and dentists; as a retarder in Portland cement and a filler in paint, paper, and fabrics; and as a fertilizer and soil conditioner. In short, the world was suddenly represented as turning on axles of gypsum.

Such protests were laughed down when it was statistically shown that the Great White Sands deposit contained a conservative *thirteen billion tons* of gypsum—a supply sufficient, it was declared, "to reproduce the fireproof walls of every skyscraper in America, to duplicate every piece of wallboard that has ever been manufactured, to replace every piece of inside decoration and statuary on the American Continent . . . and still not interfere with the one-third of the Sands which is to be set aside as a national playground."

Accordingly, in January, 1933, the choicest portion of the Sands was designated as a National Monument, and the first road into the dunes was built. On April 29, 1934, the new Monument was opened to the public by the man who had led the ten-year effort for its creation. He had been appointed Custodian at a salary of one dollar a year.

"Naturally, that salary wasn't all velvet," Tom Charles liked to remark in later years. "I had to furnish my own car, gasoline, and postage stamps . . ."

During the first year of Monument status, the dunes were visited by 34,000 persons, and the number nearly doubled during the second year. Today, as America's sand pile extraordinary, this strange white desert is the playground of some 150,000 persons annually, the peak attendance to date having been recorded on July 4, 1949, when 7,890 persons passed through the entrance gate.

Yet, of all those who come here

Western Ways photo by Ray J. Manley

◀ CRYSTALS OF SELENITE, from which the "sand that is not sand" is formed

to frolic, comparatively few know the true story of the Sands. Even geologists long disagreed on the origin of the dunes. Some contended that rain and melting snow had carried thousands of tons of gypsum in solution from the surrounding mountains, depositing it in the broad, shallow expanse of Lake Lucero, a natural evaporating pan at the southwest end of the dunes area. Gradual disappearance of the lake water leaves a huge expanse of glittering gypsum crystals. Early geologists believed that the prevailing southwesterly winds

Western Ways photo by Charles W. Herbert

New Mexico State Tourist Bureau photo

Ormal I. Sprungman photo

▲ THE GREAT WHITE SANDS provide a favorite picnic ground. But a generation ago the interior of the desert was almost unknown

◀ THE DAZZLING LIGHT of the noonday sun can produce "snow blindness," and sunburn is a frequent penalty for wearing beach costumes in these sealess sands

▼ THE FLATS between the dunes are mostly hard enough to drive over. Cars are now prohibited on the dunes because reckless driving down the steep slopes became hazardous

caught up this material and carried it to the northeast, there to form the long windrows of dunes.

To be sure, this operation is actually going on at Lake Lucero as it has for possibly a million years past, but students of geology now realize that the manufacturing process of the Great White Sands operates on a scale far greater than first believed. Today's explanation is that a great plateau once extended across much of southern New Mexico. Later, a huge block of this high country settled to form the present Tularosa Basin, between the San Andres Mountains on the west and the Sacramentos on the east. Because these flanking mountains were recognized as the

Western Ways photo by Charles W. Herbert

▲ THE SAND CASTLES and man-tracks of the holiday-seekers are obliterated as soon as a breeze resmooths the dunes, and a virgin expanse of snowlike sand awaits the next visitors

remaining ramparts of that plateau, and because both ranges carried gypsum, it seemed logical that the sunken portion of the plateau would be likewise endowed. Drilling the basin floor, geologists found beds of Permian limestone and sandstone, between the layers of which were thick beds of pure gypsum.

With this discovery was born the modern theory that, while the Great White Sands are partially the result of evaporation at Lake Lucero, a much greater portion of the gypsum comes from this underground deposit. Water passes to the surface through capillarity, dissolving the material and bringing it up in solution. Upon reaching the earth's surface, this mineral-laden water evaporates, leaving on the flats between the dunes a salt-like encrustation of pure gypsum crystals, which crumbles at the touch.

Distribution is a simple matter of wind erosion. Every passing breeze, playing its fingers over these crusty flats, loosens the crystal grains and whisks them away to pile on the rising dunes to the leeward.

This, then, is the well-organized factory of the Great White Sands—a plant that operates day and night, winter and summer, year in and year out, without labor troubles and presumably without danger of either overproduction or eventual exhaustion of natural resources.

From Monument headquarters on U.S. Highway 70, a side road leads to the heart of the Sands through a narrow swale bordered on either side by rippled white hills. It is a good road over which motorists travel smoothly and safely; yet the battle for its possession is a never-ending issue between Monument maintenance crews and the forward-marching dunes. Only by constant use of bulldozers and scrapers can the invasion of the sands be met and the way kept free for travel.

For the first several miles out of Monument headquarters, the Sands road leads through a marginal world where bird songs are occasionally heard and scattered vegetation is still to be found. Even here it is obvious that preservation of life is no simple matter.

Probably no other botanist has devoted so much study to the plant life of Great White Sands as Dr. Fred Emerson, Professor of Botany at New Mexico Highlands University, who has collected here 62 species of plants. While seven of these species are so constituted that they can push upward fast enough to keep from being buried by the dune and thus appear to be growing out of the gypsum itself, Dr. Emerson has found that all species must necessarily be rooted in the stabilized flats, either beneath or between the dunes. In some sections of the Sands, particularly near Miracle Point, the only two species of plants known to occur are the purple sand verbena and the burroweed.

The fact that plant life exists in the dunes is in itself a phenomenon of nature, since the sands are completely devoid of nitrogen. Either the plants must "muddle through" without it—a feat not commonly believed possible—or they must derive it from the underlying material or contrive, in some manner yet unknown, to extract it from the air.

Of the 60-odd species frequenting the region, none shows greater adaptability than the yucca. Like small boys striving to view a circus parade over the heads of the crowd, these spiny fellows seem to stand on tiptoe, stretching their necks to the utmost limit in an effort to keep their heads above the encroaching sand. Sometimes only a handful of dagger-tipped leaves marks the burial place of such a yucca, but the leaves will still be green.

Later, as the dune moves on, the disproportionately tall stem is exposed and the crown may be seen teetering precariously in the air. Instances have been known where such yucca stems attained a length of forty feet, nearly ten times their normal stature. Occasionally the gypsum crystallizes to form a hard, tubular casing around the stem, giving it the appearance of a stalagmite or column. In other instances, the sands are so thoroughly bound together by the roots of a plant that after the dune proper has moved on, the closely-knit hillock remains

➤ NOT A MOUNTAIN RESORT but s
thrills equivalent. The gypsum sa
much like dry snow

intact, with the plant that caused it still perched on its summit like a golf ball on a tee.

On flats between the dunes one finds Indian rice grass, tufts of grama grass, wiry, gray rabbit brush, burroweed, and ephedra. Now and then there is a small skunk brush or stunted cottonwood tree.

Possibly nothing in this marginal world endures a grimmer struggle for existence than these little cottonwoods. As the encroaching dune creeps slowly higher on the tree's trunk, the sand methodically swallows the lower branches one after another. Deprived of air and sunlight, these branches die, and, as time goes on, roots sprout in their stead. When, in the course of months or years, the dune passes on its way, its departure disentombs the buried portion of the plant, and if life still exists, new branches again sprout from the trunk. The confusing result is an upside-down tree with unanchored black roots and leafy green boughs haphazardly and hopelessly intermixed.

That this marginal world also has its share of animal life is apparent in the intricately patterned tracks that lead from the crusty lowlands to the tops of the highest dunes. Recorded in the sand as faithfully as in new-fallen snow are sprawly lizard tracks and bird tracks, the decisive thumps of strong-limbed jack rabbits, the dainty imprints of tiny cottontails, the doglike pads of foraging coyotes. For a dozen yards the delicate tracery of a pocket mouse's footprints are overlain by the pigeon-toed stride of a cruising desert skunk. Suddenly the rippled surface of the sand shows unmistakable evidence of disturbance, and a single drop of dried crimson stains the white expanse. The skunk tracks continue their pigeon-toed course across the dune. The mouse tracks are no more.

Nell Murbarger photo

▲ WHEN THE SKY BECOMES OVERCAST and the sky line is blotted out by wind-blown sand, the visitor may lose his way in the labyrinth of dunes. A tent has been known to become buried in a day

New Mexico State Tourist Bureau photo

Nowhere has protective coloration been developed to a higher degree than here in the Sands, particularly by animals that are commonly preyed upon by their neighbors. Dr. Lee R. Dice, of the University of Michigan, made an exhaustive study of pocket mice in the Tularosa Basin. He found that in the lava beds a little to the north of the Sands these rodents are nearly black in color, thus affording them protection in the dark lava rocks. In the red hills near by, the pocket mice have definitely reddish fur; while in White Sands they are pale straw color. An interesting diorama showing the three color phases in their natural habitats may

Western Ways photo by Ray J.

PLANTS manage to survive the encroaching dunes. Some yuccas have had to elongate their stems 40 feet in order to stay above the su

be seen in the museum at Monument headquarters.

White spiders also are said to occur here, and it is not unusual to glimpse small white lizards, whose pale ghostliness renders them all but invisible against the dunes where they spend their lives. An earless lizard (*Holbrookia*), described as an endemic race, and a scaly lizard (*Sceloporus*) are nearly pure white. Also there is a whiptail lizard (*Cnemidophorus*), which is considerably paler than those immediately outside the dunes.

Not all creatures, however, are endowed with this protective camouflage. Brewer's blackbirds are still black, and to see a flock of these glossy fellows alight on the gleaming sands provides one of nature's most striking studies in contrast.

Before the visitor has been long in the Monument, he is certain to note that all the dunes have one characteristic in common, which formerly encouraged a remarkable type of daredeviltry. Due to the prevailing southwesterly winds, the dunes have a gently sloping grade on their southwest exposures, while their leeward faces drop away with relative abruptness. For all its soft and velvety appearance, the crystalline material composing these dunes is heavy and firmly settled; and until Monument authorities forbade the practice, it was considered rare sport to travel over the dunes in a speeding motor car.

Zooming across the windward incline to the summit of a dune, the driver would cut the power just as his machine, in roller-coaster fashion, headed down the steep northeast declivity. With the hilarious and terrified shrieks of passengers lending drama and confusion to the experience, the car would go into a nose dive, its wheels locked and the whole propelled forward on the crest of a miniature avalanche. Reaching the base of the dune, the machine would somehow recover its balance, zoom off across the flat and up over the crest of another dune, there to stage a repeat performance.

As visitors increased in number, the practice grew extremely hazardous, and frequent signs along the road now warn against such indulgence.

Five or six miles from Monument headquarters, virtually the last of the vegetation grows, and another couple of miles carries the motorist to the end of the road. Beyond this point exploration must be on foot.

Trudging across the flats, up one

dune and down another—particularly during midday hours when the sun is high—the visitor feels he is walking through a glaring white vacuum in which nothing is real. Like a sleepwalker, he automatically lifts his feet and sets them down, yet the only evidence of progress lies in the lengthening trail of footprints he leaves behind him. To the right and left, ahead and behind, the undulating white dunes stretch away to the distant mountains. Unless shielded by dark sunglasses, few human eyes can long endure the brilliancy of this midday light, its effect being similar to the snow blindness experienced by arctic travelers.

By far the best time to see the dunes is during the first two hours after sunrise and the last hour or two before sunset. Then the low-slanting rays of the sun throw heavy shadows into the ripples and accent every slope and contour.

Photographers using light meters are apt to find that the intensity of light is even greater than their gauges will register. Picture-snappers are almost certain to overexpose their film unless they use one of the fastest shutter speeds and smallest lens openings available.

Considering this intensity of light and the complete absence of shade and surface water, one might expect this white wasteland to be an inferno. Quite the opposite is often true. The breeze that blows across the dunes frequently has something of the quality of a sea breeze, and even on the warmest days the surface of the sand may feel cool to the touch. The absence of shade and the strong reflection of sunlight from the sand can make sunburn a problem.

Near the far end of the motor road, on one of the wide flats between the dunes, is situated a large picnic ground and parking area. The National Park Service has provided stoves, tables, and benches, with pole ramadas for shade; and here several thousand persons come to disport themselves each Sunday throughout the season.

Something about the dunes seems to cast a strange spell over sojourners, and only a dyed-in-the-wool hermit could fail to find this picnic ground an interesting place in which to study humanity. Possibly its nicest feature is the almost complete absence of Thou-Shalt-Nots. Here, at last, is something that the Great American Public has discovered no way to damage.

Before the last weiner has been roasted and the last campfire has died to smoldering embers, the average Sunday evening at Great White Sands sees the picnic area tramped, tunneled, tumbled, and turned upside down. But long before another week end has rolled around—generally within 24 hours—the sand castles are leveled, the pirate caves refilled, and man-tracks obliterated, leaving the area again spotless, perfectly sculptured, and self-possessed. Responsibility for this amazing clean-up job lies with the wind, which plays lazily over the dunes, moving the sand forward on a 30-mile front at an average rate of several inches each year.

Harrowing tales of blinding sandstorms in the Great White Sands are sometimes told. It cannot be denied that a person without a good sense of direction might become lost under certain circumstances. When the wind is high, all landmarks sometimes remain obscured for hours. One scientist familiar with the region traveled in a sandstorm all day under a cloudless sky without ever seeing the sun. And when he returned to his tent, he found it entirely covered with sand. But in any normal wind, the crystallized gypsum only rolls along the surface, and if a handful is tossed into the breeze, it falls back to the ground, leaving almost no trace of dust in the air.

A story has gotten started that a herd of antelope makes its home here and has hooves that curl back like a court jester's cap, because of lack of grit to wear them down. But Monument Superintendent Johnwill Faris has never encountered such an animal during his ten years at Great White Sands, and for lack of evidence we must put the tale down as highly doubtful. Yet the story still persists, and any number of reputable persons in the Tularosa Basin will swear to its authenticity.

Then there are the transient lakes of vermilion-colored water. Spanish legends dispose of the matter conveniently by asserting that the lakes are visible only on the anniversaries of certain bloody battles. Cattlemen of the region, on the other hand, declare that the strange pools make their appearance with considerable regularity, generally in the fall of the year.

When I put this question before the New Mexico School of Mines, they parried with one of their own: "Did you ever *see* one of these lakes?" I have not. But Natt N. Dodge, Regional Naturalist, asserts that, although descriptions have exaggerated them, he has seen patches of "red" water in Lake Lucero, probably in September. What appeared to be concentrations of algae in small lagoons along the shores of the lake gave a distinctly red cast to the water.

There is still much for us to learn about the Sands. Probably no man ever knew them so thoroughly or loved them so devotedly as their first official custodian, Tom Charles.

"To you who have never seen the Sands," he wrote, shortly before his death, "I want to invite you to come, and I hope that you see them on an evening just as the setting sun breaks through a canopy of clouds above the rugged San Andres, painting the points of the hills in yellow and gold, with here and there a burning ball of fire; that the mountains themselves are purple and blue and the deep shadows of the Sands stand out against the snow white hills . . . As you linger in the twilight . . . peering into the darkness and listening to the silence of the desert, without the whisper of a single leaf, I hope that you turn, half frightened, and face the full red moon as it rises over the Sacramento Mountains, scattering its millions of diamonds over every rippled dune.

"Then you will have seen the Great White Sands."

U. S. Fish and Wildlife Service photo by Warden Carl Loy

THE ADULT SEA OTTER looks like an old man, with grizzly hair and bristly mustache, but it lives and plays like a child. At maturity, it is 55 inches long and weighs 50 pounds

MORE Sea Otters

Under the protective eye of the Fish and Wildlife Service, these fabulous "old men of the sea" are returning from the verge of extinction

BECAUSE sea otter pelts were worth their weight in gold when the Russians came to Alaska, the animal was hunted relentlessly and was eventually all but exterminated. Some pelts were said to have sold for $2500, though the average was much less. In the mad struggle for the fur trade, the early traders from Asia enslaved many of the native men, working them to death or killing them before sailing away, and there was mass murder of whole settlements of native Aleuts.

Soon after Alaska was acquired by the United States, killing of this unique animal was rigidly curtailed, and in 1910, when the otter seemed doomed, complete protection was given. During the last decade, a long-range program to increase its numbers has been under way. It is now reported that there are more than 8000 sea otters in the Aleutians-Alaskan area. These are independent of a small herd that has been rigidly protected by the state of California. In former times, sea otters were found all along the Pacific Coast.

Few photographs of the animal existed before the ones shown with this article were taken. The U.S. Fish and Wildlife Service is undertaking to create new colonies through the transplanting of small numbers to favorable areas.

During the early part of this century, about all that the Federal Agencies that were charged with the protection of the sea otters could do for the animals was to maintain secrecy about the location of small groups that were known to exist. The Agencies did not have the necessary funds for much patrol work. In the 1930's, however, the Navy and Coast Guard gathered evidence indicating that Japanese "fishing craft" might be netting sea otters illegally in Alaskan waters. It was the sighting of a Japanese vessel, indeed, in an inlet of Amchitka Island that started the present management program. The seagoing ship had entered an inlet

where no ship could possibly be afloat—according to Navy charts. The charts indicated that the inlet was filled with rocky reefs, which would surely destroy any ship. The Japanese ship, however, on sighting the Navy vessel, put on steam and sailed away, right over the "rocks." Investigations showed that the "rocks" were really rip tides that created an illusion of reefs.

In the inlet was found a large group of sea otters. Hidden away from hunters and pirates, the otters had lived and multiplied for many years. The Bureau of Fisheries then received a small appropriation from Congress for the establishment of a sea otter station on Amchitka. When the Bureau of Fisheries and the Biological Survey were consolidated in 1940 to become the Fish and Wildlife Service, the sea otter management program was given impetus.

During the war years, sea otters began to multiply in their relative security. Now there are about 4000 on Amchitka and about the same number scattered in small groups along other islands and coastal areas.

The Fish and Wildlife Service reports that the sea otter cannot live except along certain shore lines. It needs an area where the water is comparatively shallow, as off shelving beaches. In such localities sea urchins live, upon which the otters feed mainly. There also must be kelp beds, in which the otter can rest, play, and hide from killer whales. Killer whales and man are the sea otter's two worst enemies. The otters are constantly on the alert for them, occasionally shading their eyes from the glare of the sun with their paws to look for the single large fin of a killer whale cutting through the water or to spot man's boats approaching.

The sea otter has so many of the characteristics or mannerisms of people that it is often called the "child of the sea" or "old man of the sea." The two names are not as contradictory as they first appear. While the 55-inch long, 50-pound adult looks like an old man, with grizzly hair on head and shoulders and a full, bristly mustache, it lives and plays like a child. The sea otter undulates through the water with a scissors kick, now and then rolling over on its back to kick itself along with one foot—its forepaws complacently resting on its chest. The sea otter's chest also serves as its table. On it, the otter spreads sea urchins as it tears them apart. While nibbling one tasty bit, the animal is apt to lose another to the floating sea gull that lazily swims about the "table" looking for an unguarded piece of food. After finishing lunch, the otter rolls over a few times and scrubs itself on the head and neck with its paws.

To date, there is no record of sea otters being kept alive in captivity for more than a few days. Perhaps with better knowledge of their specialized food habits it may become possible. But the attempt must be regarded pessimistically until proved otherwise by careful experimentation. Meanwhile, we shall have to content ourselves with the reports that issue from the scientific custodians of this fabulous little animal.

▼ A STUDY IN COMFORT: a sea otter floating on its back and kicking itself along with one foot—its forepaws complacently resting on its chest. The chest also serves as a dinner table

U. S. Fish and Wildlife Service photo by Robert D. Jones, Jr.

A Shaggy Tree

By DOROTHY FREAS

THE SHAGBARK HICKORY

Looking up the trunk of the tree, it seems to be losing some sort of shingles. Ten-inch pieces of bark are flapping in places, but next year, when you see it again, the same sections will be hanging loosely, giving this shaggy appearance.

Hence its name, Shagbark Hickory (*Carya ovata*).

It is a tall tree, about 80 feet high, with a slender trunk. The branches come out at sharp angles and are smooth and gray.

In the spring, it grows light green flowers. By summer, there are waving branches of compound leaves (usually five), but all the squirrels and small boys wait for autumn when the large leathery nuts fall. Although hard to get to, the kernel is amply rewarding.

The wood of this tree has commercial value. It is a long-wearing lumber, good for ax handles and wagon wheels, where toughness is necessary.

THE LARGE leathery nuts attract squirrels and small boys in the fall

THE BARK flaps like loose shingles in the wind

THE FIRST ASCENT OF EL SANGAY *Continued from page 221*

ma herrani. The mossy outside of the nest, in a niche twenty feet above the stream, was soaked like a sponge and dripped water continuously. Neverthless, the interior was dry. Two weeks later the owner was still working on it! The perseverence of these birds through weeks of storm was beyond human comprehension. That this feathered electron, splashed with the fire of the tropics, should choose as an abode a barren, water-soaked wilderness of ash left the mentality of luxury-craving humans in complete coma.

Not 100 feet away on the same bluff was the nest of a still rarer hummingbird, the Black-throated Bronze-tail, *Metallura williami atrigularis* Salvin. Its home, too, had never before been found. Two other nests were discovered in the paja grass in the same valley, one of them beside a large rock in the stream.

The place where three rivers came together, the Indians called "Tres Aguas." The outlook here was not auspicious. We were facing the Rio Negro. In its angry waters disaster lurked. The previous evening the Alao peons had refused to build an adequate *chozo*, or lean-to of grass. They huddled all night and arose wet and disgruntled. The "waterproof" covers of our sleeping bags leaked like sieves. Films and cartridges were wet. The drenched wood could not be coaxed into flame. We ate cold meals. We were in a cul-de-sac between mountain walls and could see nothing but fog and mist. Even the two faithful Quechuas were discouraged.

On the twenty-fourth, Waddell and Lewis arrived with six sullen peons. On the twenty-fifth, I gave orders to cross the river. The peons revolted. They pointed with fear at the rising El Negro and protested that, if we crossed, the daily rains would swell it to frightful proportions and prevent return. While I attempted to dispel the leader's fears, the rest of the peons slipped through the grass and fled over the mountain. They took our remaining venison. Terry and Waddell chased them in vain. For three days we waited—and watched food supplies diminish. Waddell went to Alao, sleeping in the snow on a high mountain range without adequate covering, and returned with new peons and a cheering letter from my wife. Meanwhile the rains continued. Dryness was no longer an exact state—only a comparison with something more water-soaked. The encouraging letter and the lucky kill of a deer[5] by the leader helped us to carry on and essay the Negro.

The fording of the river was accomplished without injury or loss of equipment, and the fears of the peons subsided temporarily. We climbed to the mountaintops again.

[5]This species, of which we took several skins to the States, proved to be *Odocoileus columbicus consul*, a very rare animal. Dr. Wilfred H. Osgood of the Chicago Natural History Museum advised that there was at the time only one specimen in the museums of the world—a female in Stockholm, Sweden.

Following a watershed that gave uncertain footing on its jagged edges, we came to a jutting escarpment, which we called Desolation View. No one could exaggerate the ghastly panorama that filled the enormous basin below us. It was the Grand Canyon all over again but done in blacks and livid grays and filled with a spectral atmosphere. We continued along the knife-edge for the rest of the day. At times it was only two feet wide, with yawning chasms on each side. Late in the afternoon it opened out into a wide plateau, more than 13,000 feet in altitude and covered with endless paja and a few stunted trees. The leaves and trunks resembled pear trees, but the yellow flowers reminded one of flat-topped goldenrods. On the eastern escarpment of the plateau, Lewis located dilapidated chozos made of grass. These may have been the remnants of Dyott's Windy Ridge Camp, the last trace of his route that we encountered. The peons called it "Carniceria" (the Meat Market), because of the tapirs available. This is probably not the "Carniceria" of G. Edward Lewis' article in *National Geographic* Magazine, January 1950, page 134.

The next morning Terry took the peons back to Tres Aguas to bring up the rest of the supplies. So diminished was their number that double trips had to be made each time camp was moved. Terry's feet were now badly infected, but with characteristic disregard of self he made the return trip in one day.

From Windy Ridge to his Cinder Gap Camp, Commander Dyott tried two routes, one along the plateau, the other into the Labyrinth. Of the latter, he said, "A worse one could not have been chosen!" As our peons also refused to follow the plateau, Lewis undertook a reconnaissance into the Labyrinth with the only Indian who still claimed to know Dyott's route. They lost themselves in its intricacies, and the Indian finally admitted ignorance of Dyott's course. But the killing of a deer and a rare tapir, *Tapirus roulini,* revived our waning courage.

That night we witnessed an awe-inspiring vision. As we stood on the brink of the escarpment, the filmy curtains of the Shroud rolled back. Gradually the mysterious God of the Snows was disrobed before our eyes. Drape after drape slipped away and dissolved. The disrobing began from the base upward. First the great flanking buttresses of ash and lava took form; next the lower edges of the snow fields, where irregular tongues of white forked into the gouged sides; finally the icy shoulders shook themselves free, and the perfect cone came out against a methyl blue sky. Save for a singular black spot near the apex, the mighty head was perfect—a sublime and majestic being who might have come to Earth from chaotic mountains of the Moon to take part in creation of abysses and chasms as strange as those of our satellite—abysses that now were taking on grotesque shapes in the palpitating gulf at our feet. As we gazed, a huge billowing cloud of pure gold swept in from the "Oriente" and, half circling the mountain, passed off to the south. To the east the sky assumed a violet light, while to the west cloud masses, already dulled by approaching night, leaped up in pink foam. Night brought the usual deluge and biting temperatures.

In the morning the peons refused to move. They were tired and wanted to feast on tapir and deer. Neither arguments nor offers moved them. Their only answer was, "Mañana!" I feared desertion, so during the day they were kept under surveillance.

Personally, I spent the night listening for sounds from the chozos. Another defection would spell failure. With fatigue and the accumulated pain of hardship and frustration heavy upon us, this was in some ways the darkest moment of our expedition.

(*In the next issue of* NATURAL HISTORY, *the author will tell of the remaining episodes in the first successful attempt to scale El Sangay.*)

HOAX OR FAIR WARNING *Continued from page 227*

first glance. Of course, a mimic must never become so numerous or conspicuous that its potential enemies can easily "catch on." The value of mimicry would be destroyed if many of the mimics could be eaten before the creature preying on them tackled the dangerous or unpalatable model.

Unfortunately, a great deal of uncritical writing has been published on mimicry among butterflies without clear evidence that the model is less desirable as food than the mimic. The similarity in coloration between the Viceroy Butterfly (*Basilarchia*) and the Monarch (*Danaüs*) has been pointed out repeatedly without a good case being made for any relationship beyond coincidence. The range of the two is different. They do not fly in a similar manner or frequent the same areas to any appreciable extent. The viceroy is regularly smaller than most monarch butterflies. Yet little has been done to settle the argument one way or the other. The butterflies must be studied under natural conditions—in the open, while they are alive and free. The question cannot be settled in an armchair between bookcase and butterfly collection. The best evidence that has come to the authors' attention was provided by an inquisitive ornithologist who tasted both of these butterflies to find out. He didn't like either, but then he was a bird watcher and not a bird. And in this country no one has gone to much trouble to show how many or how few birds catch significant numbers of butterflies and which of the insects are most usual prey. The problem is far from settled. A biting ant or a stinging wasp, a poisonous snake or a scented skunk, provide conclusive evidence in far shorter time. There is no end to the experiments and observations that the naturalist can make in this field of inquiry, and it is a study that has a close bearing on some important aspects of evolution.

ANIMALS OF THE AVALANCHE

Continued from page 214

Winter comes quickly on the high mountain slopes and covers the area with several feet of snow. This leaves only three months that are at all mild, and into this short time is squeezed what we know as spring, summer, and fall. Snowstorms in midsummer are not too unusual, and the temperature nightly drops below freezing.

Winter turns the high mountains into an abandoned wilderness of snow. Most animals either migrate or hibernate to escape the icy blasts. The rosy finches, which normally feed among the summer snow fields, move down into the valleys, and elk herds migrate as much as 50 miles in order to reach mild winter range. The snowshoe rabbit turns white and uses the big snowshoes on his feet to move over the surface of the snow and feed on protruding plants.

Marmots are undoubtedly the laziest members of the alpine clan. They spend about three-fourths of their lives in a hibernating sleep. There is little time between when they emerge in May or June and when they must again begin storing great layers of fat for the big sleep. The callos don't spend quite as much time hibernating as the marmots, nor do they sleep as soundly. It is quite possible that they awake at intervals to munch on food stores.

The cony has devised by far the cleverest method of meeting the winter conditions. In late summer it very industriously gathers food for the winter. Cutting a bundle of grasses almost as big as its body, the cony shoves these crosswise into its mouth and then bounds back to the "hay barn." This is a flat space that has been chosen because it is dry and airy and because there is a jutting rock overhead for shelter from rain and snow—an ideal choice from the standpoint of farming science. Each day a new layer of freshly cut fodder is added to the hay pile, and by the time the first snows arrive the cony has about a bushel of greens that have slowly cured into the most edible hay imaginable. The cony's careful treatment preserves the natural colors of the plants and their fresh fragrance.

What a life of ease the pika has arranged for himself! When several feet of snow pile up on top of his rockslide, most enemies are shut out for the winter. The blanket of snow keeps him protected from temperatures that may drop to 50 below zero in the bleak outerworld. In complete comfort Mister Cony can then relax in his easy chair of soft grass and slowly munch on his larder of well-cured hay.

He exemplifies this group of alpine adventurers who have chosen to live among the talus slides. In an area of extremes in wind, temperature, and storms, they have found protection and a comfortable existence in the rock castles.

MUSEUM ANNOUCEMENTS

Rare Butterflies and Moths

A select sample from what is believed to be the finest and most colorful private collection of moths and butterflies in the world will be on public display at the American Museum until May 11. The exhibit, entitled "Velvet Wings," contains some of the outstanding specimens from the late Mr. Frank Johnson's famous collection, recently acquired by the Museum.

Among the specimens are moths with nearly completely transparent wings—scaled only along the edges—and others with large "windows" in each wing. Other unusual species have tails six inches long from the outer margins of the hind wings. Outstanding among the butterfly groups are those whose wings change color with the reflection of light, from a brilliant blue to black or from a vivid green to tan or white. Represented in the collection are many of the most beautifully colored and patterned butterflies known to exist.

The collection, which recently arrived at the Museum, brings to some 300,000 the number of insects donated by Mr. Johnson to the Museum. Though primarily a businessman, Mr. Johnson's hobby had developed so that he was both a collector and purchaser of insects. He financed several scientists to arrange and prepare reports on particular groups of insects. In addition to aiding collectors in Peru, Brazil, Colombia, Ecuador, Argentina, Guatemala, Mexico, and the West Indies, he sent out numerous expeditions in quest of unusual specimens.

"Oscarette"

Plans for the fifth annual national contest for the best school-made motion picture film have been announced. The contest is sponsored by the American Museum's Service Center in connection with the annual Audio-Visual Aids Institute programs.

The competition is open to all students of junior and senior high schools in the United States. The films must be 16 mm., planned and produced entirely by the pupils, and must not exceed 100 feet in length. A school may submit more than one entry but will not receive more than a single award a year. To enter the competition, the faculty adviser of the group of student movie-makers must secure an entry blank from the Museum, fill it out, and return it on or before June 15, 1950. The film must be sent to the Museum Service Center by December 1, 1950.

The selection of the winning film will be made by a panel of judges. In the event that five films come up to the standards of the Museum, an "Award of Merit" will be given for each of the films accorded second, third, fourth, and fifth places. Last year's "Oscar" was awarded to "Animal Antics," produced by students of George Washington High School, New York, N. Y.

The Planetarium Show

During May, "Our Battle-scarred Earth," a discussion of recent theories, will provide one of the most thought-provoking demonstrations the Planetarium has ever offered.

Other Special Exhibits at the American Museum

May 4—May 14

Hobby Show for Older People
Sponsored by the
Welfare Council of New York City
Knitting, sewing, jewelry-making, painting, etc.

May 6—June 4

Ceremonies of the Southwest
Lithographs by Ira Moskowitz

May 16—June 16

Second Annual Exhibition of
The New York Entomological Society

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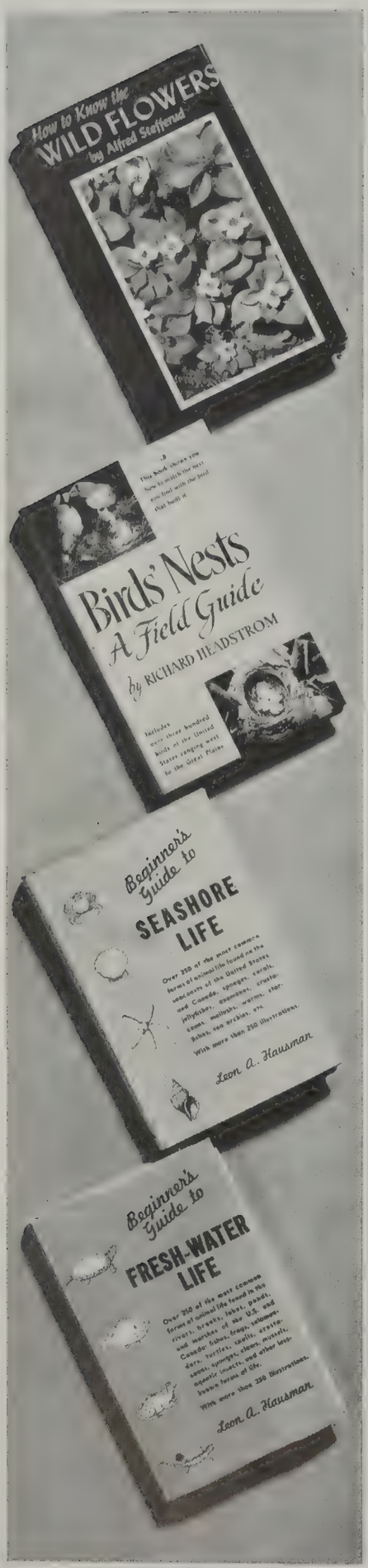
June NATURAL HISTORY 1950

ploring the Desert of Death • Cherished Wilderness

en Canyon • Ben East: The Kettledrum Choir of June



New Field Books

Postage 8¢ on each book

HOW TO KNOW THE WILDFLOWERS — $2.00

by Alfred Stefferud

As an introduction to the fascinating world of wildflowers, this book will delight readers from eight to eighty. 140 illustrations by Sidney H. Horn.

BIRDS NESTS, A FIELD GUIDE — $2.75

by Richard Headstrom

This book shows you how to match the nest you find with the bird that built it, and includes over 300 birds of the United States ranging west to the Great Plains.

BEGINNER'S GUIDE TO SEASHORE LIFE — $2.00

by Leon A. Hausman

This handy little volume describes over 250 of the most common forms of animal life found on the east and west coasts of the U.S. and Canada. Sponges, corals, jellyfish, anemones, crustaceans, mollusks, worms, starfishes, sea urchins, etc., are all included. Much valuable information is given on their habits, locations, and color. Over 250 black-and-white illustrations. 128 pages.

BEGINNER'S GUIDE TO FRESH-WATER LIFE — $2.00

by Leon A. Hausman

Here are descriptions and illustrations of over 250 of the most common forms of fresh-water life found in the rivers, brooks, lakes, ponds, and marshes of the U.S. and Canada. Included are fishes, frogs, turtles, reptiles, crustaceans, sponges, clams, mussels, snails, aquatic insects, and other less-known forms of animal life. Over 250 black-and-white illustrations. 128 pages.

FIELD BOOK OF SEASHORE LIFE — $6.00

by Roy Waldo Miner

A comprehensive field guide to invertebrate marine animals usually found along the seashore from high to low tide marks and in the shallow seas to the hundred-fathom line. The range covered includes the Atlantic coast from Nova Scotia to Cape Hatteras. Most of the species, including marine protozoa, sponges, coelenterates, annulates, mollusks, echinoderms, and even the lower chordate animals, and other groups, are pictured and described. A book for the layman as well as for the student and research worker. Superbly illustrated with 24 color plates and over 200 line cuts covering approximately 1300 species. This classic has been 20 years in preparation. (For publication July, 1950. Probable price: $6.00).

SHELL COLLECTOR'S HANDBOOK — $4.00

by A. Hyatt Verrill

An invaluable guide for the beginner, the amateur conchologist, and those who want to make sea shells a hobby. It fills a long-felt want among shell collectors by describing the strange ways of shells, their lives and habits, how they are formed, where they live, how and where to search for shells, and how to prepare and classify them. Descriptions of a great many of the more widely known shells from all parts of the world with their Latin and English names are given, together with a simplified method for their classification and identification. Over 100 line drawings and photographs. Approx. 256 pages. 5⅜ x 8.

FIELD BOOK OF NATURE ACTIVITIES — $3.95

by William Hillcourt

This is an indispensable companion volume to each of the other Putnam Nature Field Books. It is also outstanding in itself. It gives a broad outline of all the exciting possibilities within each field of nature study and provides a wealth of ideas for getting the greatest amount of enjoyment out of a nature hobby. There are more than 500 specific suggestions for projects—things to do and things to know—in the field of nature. It is extensively illustrated with numerous drawings and diagrams and is written by the National Director of Scoutcraft of the Boy Scouts of America.

The BOOK SHOP

THE AMERICAN MUSEUM OF NATURAL HISTORY

77th STREET AND CENTRAL PARK WEST, NEW YORK 24, N. Y.

LETTERS

Sea Moth

SIRS:

. . . Can you give me the scientific name and distribution of a fish that I know only as "Pegasus"? Despite its name, it is no kin to the sea horse but rather a sort of "boxfish." Specimens occasionally reach this country, dried, in collections of oriental insects, for in this state the fish is sometimes mistaken for a large locust! I understand that it is quite fragile in life and that it spends most of its time at the surface of the water, close to floating masses of kelp . . . The one specimen I have seen was in the private collection of a well-known museum curator, who, for some reason, does not seem willing to give me any further information on the fish. How rare it actually may be, I do not know, but I have been in correspondence with Mme. du Breuil of the Hong Kong Biological Society in the hope that she may be able to obtain a dried specimen for me. Could you give me a little information that might aid this good lady in securing one?

HENRY A. NICHOLS.

Costa Mesa, Calif.

Mr. John T. Nichols, Curator of Fishes at the American Museum, offers the following information:

It is my impression that the dried specimens referred to come from Japan. In this case, they are probably the Japanese species, *Pegasus umitengu,* which is depicted here from a drawing in Jordan's *Fishes.* *

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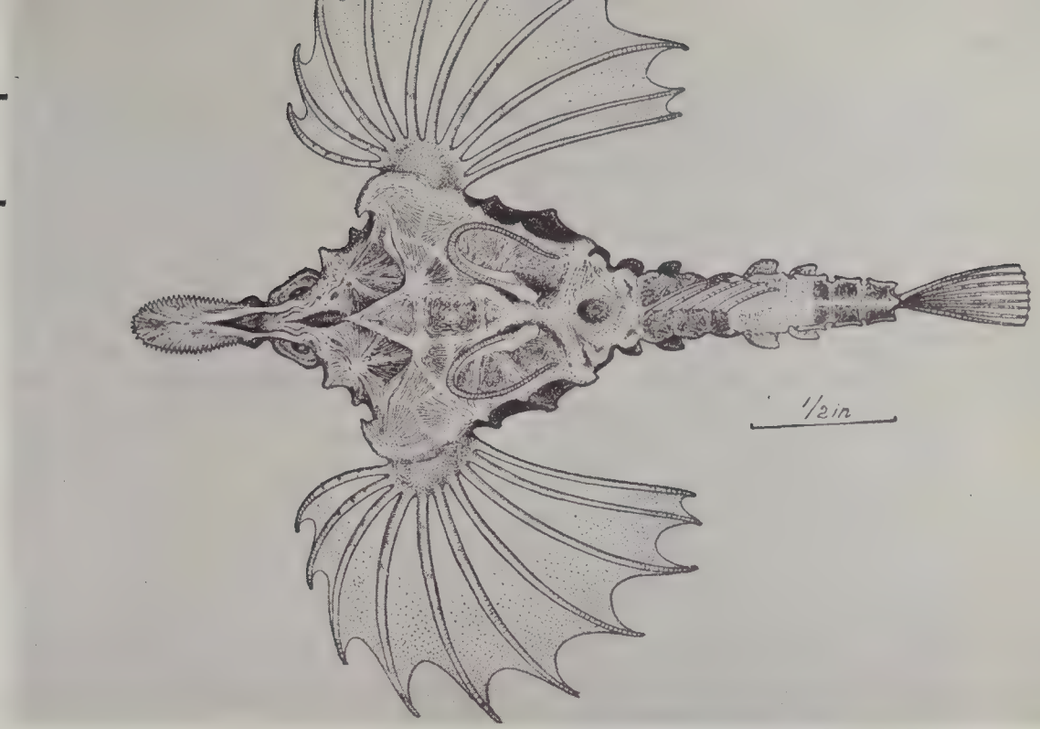
* D. Appleton and Co., 1925.



from Jordan's Fishes

▲ PEGASUS UMITENGU, also known as sea moth. (Viewed from below)

The Pegasidae are a family of peculiar little fishes, rarely exceeding four inches in length. They are found in oriental seas, often drifting with the currents. They are also known as dragonfishes or sea moths. Their relationship to other fishes is very uncertain. Different authors have thought them to be related to such unlike fishes as the sculpin, stickleback, and sea horse.

Big Fungus

SIRS:

The gourmet rhapsodizes over a steak smothered in mushrooms; but recently a squirrel hunter brought me a large edible mushroom that was capable of smothering quite a few large steaks. I confessed to Mr. Martin Fuhrer, who brought it to the house, that the growth was a strange vegetable to me. Reference to Graham's *Mushrooms of the Great Lakes Region* revealed that it was *Polyporus frondosus,* a large edible fungus that is related to the woody brackets found so commonly on standing or fallen trees. It usually grows on the roots of living trees, and it causes a disease known as "spongy butt rot." Infected trees are deprived of a part of their anchorage and are susceptible to wind-throw.

Our specimen weighed fifteen pounds on the bathroom scales. It was roughly hemispherical in shape, 38 cm. (15 inches) high, and the long axis of the base measured 60 cm. (24 inches). I believe we can say that this specimen reached a very respectable size, because authorities (Lowe: *Bull. N. Y. State Coll. Forestry,* Tech. Publ. 60, p. 38) state that this species may reach a diameter of 50 cm. It grew from the ground on a central stem which branched repeatedly until more than 50 large pilei or caps formed a thickly imbricated roof over the whole structure.

Because of its enormous size, I decided to photograph it next to the trunk of an oak under simulated natural circumstances. A burr oak was convenient. Much to my surprise an eight-pound specimen of *P. frondosus* was growing under this very tree, so I photographed both together. The smaller specimen in front is still attached to its buried wood; the large specimen fitted nicely between it and the trunk of the large oak. Even the smaller mushroom measured well over a foot in diameter, the maximum size reported by Graham. The smaller specimen was cut in two, and the halves were photographed to show the branches that support the imbricated roof.

PAUL D. HARWOOD.

Ashland, O.

◀ FIFTEEN POUNDS of edible fungus (upper specimen)

▼ CROSS SECTION of the smaller mushroom

Was He a Genius Among Birds?

SIRS:

The bobolink is one of my favorite singers. No feathered songster of field or forest expresses more fully his joy of living.

On a Maine farm some years ago, one of them made me wonder if there are individual birds with exceptional intelligence and perhaps some creative ability.

One dewy morning I was driving the cows down the lane just as the sun was rising. From bush, tall reed, and fence post the bobolinks were telling the world of their joy in the beautiful morning. Suddenly I heard something new, something added to their standard song. I had heard their song so often that I knew every liquid note, and this new song was an amazing innovation.

Looking around, I soon spotted the singer. Down the lane between two fence posts the top board had been placed on its side. Strutting slowly back and forth on this dewy platform was an unusually large male bobolink. With wings slightly spread, he was singing the novel song. Never did Caruso strut the stage and send out his glorious voice more proudly than did this feathered virtuoso. I listened while he sang his song over and over; to the usual song of bobolinks he had added another verse. The cadence was the same, but it differed from the regular song.

Morning after morning I listened for this song, but I never heard it again. Is it possible that occasionally there is an exceptional bird with creative ability?

Sarasota, Fla. FRANK E. WATTS.

The following comments are offered by Dr. John T. Zimmer, Curator of the Department of Birds at the American Museum:

It is very doubtful if any creative ability can be ascribed to this bobolink. Although most individuals of a given species in any region have very similar songs, there are numerous variations due to a number of causes, and it is sometimes possible to identify particular birds by their performance.

The ability to sing is an inherited trait, and to a certain extent, the character and limitations of the song are also inherited. The conformation of the syrinx and its musculature govern much of this ability, but within certain limits variation is possible. Development of the voice is somewhat a matter of growth as it is in humans, and a young cockerel, for example, is not so accomplished a performer as an old bird whose voice may have served as a model. At the other extreme, there are a few species whose young are vocal while the adults are voiceless. Canaries have been reared where they could hear only the songs of another species, and they acquired the song of their unwitting tutors instead of that of their parents. How much of a bird's song is inherited and how much acquired is still a question. Different species may be taught to whistle quite unbirdlike tunes.

Mimicry is undoubtedly widespread among birds. Quite frequently some individual bird will interpolate a few notes from the song of another species or even some extraneous sounds; but it is not always possible to recognize what is being imitated. A still different type of variation may occur when the syrinx is malformed or injured.

In addition to various "call notes," some species have more than one type of song, including, perhaps, an elaborate flight song, and portions of these could, conceivably, be added sometimes to the common production. As far as I know, however, the bobolink has but the one type of song.

Bird song must have evolved from some simpler ancestral utterances, and it may still go on developing into something more elaborate and finished. If evolution is to proceed, some individuals must sometime excel their fellows. The song of a species, in any case, occasionally varies in different parts of its range, but the differences are demonstrated by the general population and not by individuals.

We come back again to our bobolink. Perhaps not all bobolinks would be capable of a similar performance, but that the bird in question was deliberately "composing" is beyond any possibility supported by biological data.

Who Killed Those Robins?

SIRS:

A pair of robins built a nest in a crotch of one of our elms, and we could look down into the nest from one of our upper windows. In time we saw two baby robins in the nest. When they were not quite half grown, a mysterious tragedy befell them. We saw them in the nest at twilight, and a little later the mother bird was brooding them. In the morning the nest was empty. Upon investigating, we found the two little birds dead on the ground about ten feet from the tree where the nest was. They had not been bitten or mangled in any way.

We thought at first that an owl might have taken the mother bird and that she might have dragged the young out in her struggle. To our surprise, however, we soon saw the mother and father robin gathering dried grass and carrying it to a neighboring tree, where they were busily building a new nest.

Do parent birds, obeying some strange instinct of their own, ever destroy their young?

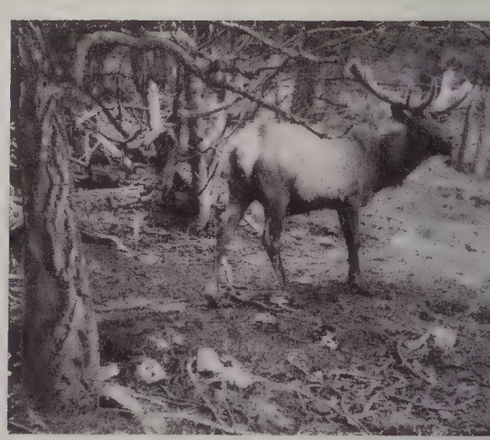
Caledonia, N. Y. CARLOTTA E. LONG.

The following information is offered by Dr. John T. Zimmer of the American Museum's Bird Department:

Accusations are sometimes leveled against wild birds for supposedly killing their own young, but I know of no authentic instance of it. Young ones may be severely pecked by other than their parents when they intrude in a family gathering, as in the case of barnyard fowls and other terrestrial species. But these attacks are usually not severe enough to cause the death of the intruder, and they could hardly occur among arboreal birds. Stories of parents carrying poisonous berries to feed their young when the latter have been caught and caged are beyond credence.

When young birds die in the nest, the family life of the survivors goes on unchecked, and when the dead youngsters fail to respond to the parents' efforts to feed them, they apparently cease to be recognized as offspring and may eventually be removed with other debris in the parents' routine procedure of cleaning the nest. Even when all the young have succumbed, the old birds are likely to continue efforts to feed them for at least a short time before they abandon the nest. If early enough in the season, a new attempt to rear a family may be made, otherwise not.

What killed the young robins in the nest you describe is problematical. It is hardly likely that a brooding parent left the nest so precipitously as to have dragged out both young. It is far more probable that the birds had been left without parental protection for some unknown reason during a chilly night and succumbed to exposure. They were found in the morning quite dead but without sign of injury, and the chances are that they had died in the nest some time before they were removed by the old birds. In any case, there is no reason to suppose that they had been killed by their parents.



Bull Elk

SIRS:

This picture of a bull elk with horns in the velvet was taken last June. I first knew of the elk's presence when I was walking down a small hill that leveled off into a secluded park. The elk was lying down, and the horns were all that were visible at first. Going closer as cautiously as I could, I took a picture when he first got up. Then, by keeping trees between myself and the elk, he let me approach his clearing, and I was able to get two more pictures at about fifteen feet as he stood and posed for me. However, he appeared to be getting

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

F. Trubee Davison, President | Wayne M. Faunce, Vice-Director In Charge of Publications | Albert E. Parr, Director

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You will find Natural History *Magazine indexed in* Readers' Guide to Periodical Literature *in your library*

The Cover This Month

Looking out from this month's cover is handsome Chief John Hunter of the Sarsi Indian Tribe, Alberta, Canada. Every summer, after participating in the famous "stampede" and rodeo at Calgary, the Indians move their tepees west to the Canadian Rockies resort town of Banff, where Jack Breed snapped this portrait. There the Indians put on their own show—the Banff Indian Days Celebration. Tribal feathers and finery replace the Indians' workaday dungarees, and all members of the tribe attending come forth in their brightest war paint.

The Sarsi Indian group, numbering a little over 200 members, is one of several small tribes living in western Canada. Descended from Athabascan stock, like our own Navajo and Apache, they live on a protected reservation a few miles southwest of Calgary, where they engage in farming and act as guides for hunting, fishing, and survey parties. John Hunter is one of the best known of the Sarsi and one of the most modern.

The photograph was taken on 2¼-inch Anscocolor film at 1/50th second, stop F5.6.

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The American Museum is open to the public every day in the year without charge

YOUR NEW BOOKS

Sun in the Sky • Rio Grande • U.S.S.R.
Native Arts • Out of the Earth • Narcotics

SUN IN THE SKY

- - - - by Walter Collins O'Kane

University of Oklahoma Press, $4.00
261 pp., 91 photos, 4 maps

THE Hopi Indians of northeastern Arizona have long attracted anthropologists and writers alike, and the literature dealing with this conservative Pueblo tribe is very extensive indeed. Yet the descriptions of various aspects of Hopi culture are widely scattered in technical monographs and professional journals, most of them forbidding and inaccessible to the layman. Mr. O'Kane—who, surprisingly enough, is an entomologist—has thus performed a very real service in making available for the average reader a well-rounded, popular portrayal of the Hopi way of life.

Although the book is not addressed to a professional audience, it is obviously an honest, firsthand account, based in large part upon the author's residence in Hopi villages and his personal contacts with the Indians. As such it cannot be ignored by anthropologists; in fact, it contains some material that seems entirely new. Indeed, the treatment of Hopi manufacturers is in some respects more complete and systematic than that found in the technical literature.

A nice balance is maintained throughout between Hopi culture as it exists today and the ancient traditional patterns, now gradually disappearing. It is only natural, however, that in attempting to deal with the totality of Hopi culture, the author should delineate certain aspects more successfully than others. Generally speaking, the chapters on economic life and material culture receive more adequate treatment than those concerned with social and political organization.

The presentation is simple, straightforward, and unpretentious; yet, it leaves the reader with an appreciation of contemporary Hopi life, as well as of the traditional roots extending back into the pre-Columbian past. Although not all of the illustrations are noteworthy as photographs, they do depict some subjects that have not, to the reviewer's knowledge, been illustrated previously. It is to be regretted, however, that the author did not provide a more adequate bibliography.

H. T. TSCHOPIK, JR.

OUT OF THE EARTH

- - - - - - - - by Louis Bromfield

Harper & Brothers, $4.00
305 pp., 32 illusts.

THE science of agriculture and the art of farming are slowly fusing into a practice of husbandry that gives hope for a more productive world. This process of fusion has been accelerating in recent years, and many isolated investigations and scattered judgments are being integrated with new meanings. Louis Bromfield in *Out of the Earth* has brought many of these developments into a focus, that of the practical farmer dealing with the realities of his land, the growth of his animals, and the productivity of his crops, whose synthesis is, broadly, better living.

Nearly all of the chapters are completed discussions within themselves, possibly because many of them appeared as separate articles in journals and had to stand alone. Thus there are many ideas, statements, and phrases that are repeated many times over; but for those of us who are likely to read the book as a whole and then study it intensively in parts, the repetition is pointed and valuable.

The book is not and is not intended to be scientific in the sense of attempting to prove effects from causes or to develop inescapable conclusions from controlled experimentation. It does, however, point up the fact that all people can be intelligent in observation, imaginative in application of experimental procedures, and sane in the evaluation of results.

The chapters on the uses of organic materials, on the extension of usable soils to subsoils, on the control and improvement of the water table, on planned farm livestock economy, and on regional opportunities in husbandry have special and intensive meanings for all whose roots are in the soil, from the backyard gardener to the extensive farmer. The rest of the book, which brings a deeper understanding of the meaning of agriculture in this modern world, should be read by all who enjoy the present one and respect the one of the future.

CHARLES RUSSELL

NATURAL REGIONS OF THE U.S.S.R.

- - - - - - - - - - - - - by L. S. Berg

Translated from the Russian by O. A. Titelbaum. Edited by J. A. Morrison and C. C. Nikiforoff

The Macmillan Co., $10.00
436 pp., 81 illusts., 23 maps, 30 tables

FROM Arctic tundra to the subtropics and from land below sea level to some of the earth's highest mountains, the U.S.S.R. is one of the most varied countries. This geographic panorama has deeply influenced the characters of the peoples of the Soviet Union, and their history. It is certainly going to influence the future history of the whole world. There is, therefore, crucial importance in having available in English an authoritative and generally adequate description of the physical geography of the U.S.S.R.

This work was first published in Russian in 1936, and it is the standard treatment of the subject within Russia, itself. The author, a leading Soviet geographer, is an extremely versatile scientist, probably best known in this country as an ichthyologist. The translation is said to be scrupulously faithful to the ori-

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ginal, but it is also clear, sufficiently idiomatic, and readable in English. Special care has been devoted to the tricky problem of translating names of plants and animals. The photographic plates are not those appearing in the Russian edition but are a good selection from other sources.

Treatment is regional by zones defined climatically, topographically, and biologically. The whole vast area is divided into 20 major zones, each the subject of a chapter with systematic discussion of definition, climate, relief, soils, vegetation, and fauna, plus an occasional special heading when appropriate. Arrangement and style are those of a rather dry textbook, and the book will hardly be read for pleasure, but it is an invaluable work for reference and study.

G. G. Simpson

The Rio Grande: River of Destiny

- - - - - - - - - - - by Laura Gilpin

Duell, Sloan & Pearce, $6.00
243 pp., 234 photos, 5 maps

This is a very handsome and impressive book, magnificently illustrated and written with directness and great sensitivity. As in her earlier camera chronicles, Laura Gilpin's photographs are of exceptional quality, and they portray the landscape and the peoples of the Rio Grande Valley with imagination and drama.

The book, the author tells us, is intended as "a portrait of a river with a sequence of related subjects." That it more than succeeds in this aim is evident, but in a sense it is also a photographic record of the history of the Southwest. Like all great rivers, the Rio Grande has dominated the lives of the inhabitants of its valley from the prehistoric past to the present day. Important events in the histories first of the Indians and later of the Spanish conquistadores, colonists, and Mexicans were enacted along its banks. Still later came the Anglo-American farmers, cowmen, prospectors, and industrialists. The people and monuments of the Rio Grande Valley reflect these several racial and cultural heritages as the author's camera roams the river from its source in the San Juan Mountains to its delta on the Gulf of Mexico.

The contents are divided into three principal sections, entitled respectively "The Source," "Midstream," and "The Border." In addition, a useful appendix includes a glossary, chronology, bibliography, and miscellaneous statistics concerning the river. The accompanying text supplements the photographic essay, highlighting the outstanding events of Southwestern history as these unfolded down the length and breadth of the Rio Grande Valley.

Although, perhaps, the point is not driven home with sufficient emphasis, Miss Gilpin's pictorial record reveals all too clearly the progressive desiccation of the Rio Grande as the great river approaches its delta, and points to the urgent need for additional and more stringent conservation measures.

H. T. Tschopik, Jr.

Flight from Reality

- - - - - - - - - by Norman Taylor

Duell, Sloan & Pearce, $3.50
237 pp.

All "slaves of habit," whether it be of coffee, tea, tobacco, or tequilla, should understand and appreciate the title of this book. For here we have a general and lively account of some of the world's most interesting plants—chiefly those producing narcotics. The sort of "escapism" that these plants, through their alkaloids, may aid is best conjured up by some of the chapter headings: "The Pleasant Assassin," "The Abyss of Divine Enjoyment," "Come and Expel the Green Pain," "The Lively Image and Pattern of Hell."

The reader may meet old acquaintances in this volume like the ones mentioned above; in addition, appear a galaxy of unusual and largely unfamiliar botanicals including caapi and coca, kava, hashish, and peyotl. Of some of these Mr. Taylor speaks with firsthand knowledge; for the others he has digested a sizable bibliography. Of their use the author seems to agree with the Guatemalan Indian who, to explain his addiction to the alcohol of aguardiente, replied: "A man must sometime take a rest from his memory."

Some minor errors of fact have crept into this book. For example: Inca Peru included no part of Colombia but did include the northern half of Chile (p. 147); the coat-of-arms of Peru includes a llama (not a vicuña) and a cinchona tree (not a coca leaf) (p. 150); the coca shrub may attain a height of six feet, and it is very doubtful if individual cocales produce for centuries (p. 155); and there were never "ancient Caribs" in Haiti (p. 161).

W. H. Hodge

Of Men and Mountains

- - - - - - by William O. Douglas

Harper & Brothers, $4.00
338 pp.

This is a book of the out-of-doors, an account of the author's days spent in the mountains of Washington and Oregon. These sojourns in the magnificent wilderness of the Pacific Northwest begin as boyhood exploits and are continued as outings and spiritual refreshment in the busy life of a man devoted to public affairs.

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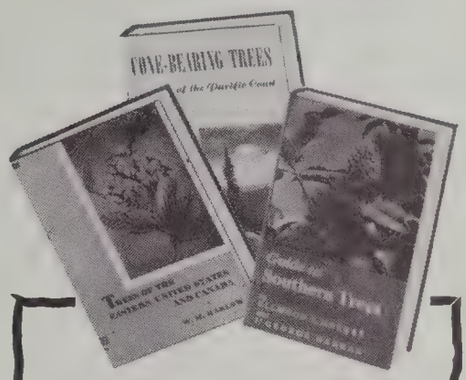

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As a small child, William Douglas suffered an attack of infantile paralysis that threatened to leave him a cripple. His legs were weak, and he turned to exercise in the open as a systematic campaign to recover their use. How well this determination succeeded is amply evidenced by the rugged experiences he later had in mountain climbing. The town of Yakima, Washington, was his home for many years, and he was handy to an environment that developed him physically and induced a love and an understanding of nature. Whenever possible, he struck off into a primeval environment, and in his later years this habit brought not only an intimate firsthand knowledge of these western mountains, forests, and streams but periods of relaxation from human congestions and regimented behavior.

The reader of this book who is a lover of the out-of-doors (and that should include most of us) will find much to enjoy. There are episodes of camp life, glorious scenery, storms and sunshine, much about plant and animal life, and a great deal about trout fishing. The author is a keen observer; he is well-read in natural history, and he is on familiar terms with prominent naturalists. He makes the most of his hours with nature. He documents his piscatorial opinions with citations from Izaak

Continued on page 288

From the cliff statues of Bamiyan to the mysterious ghost city of Peshawarun—an expedition searching for traces of ancient man in little-known portions of Central Asia

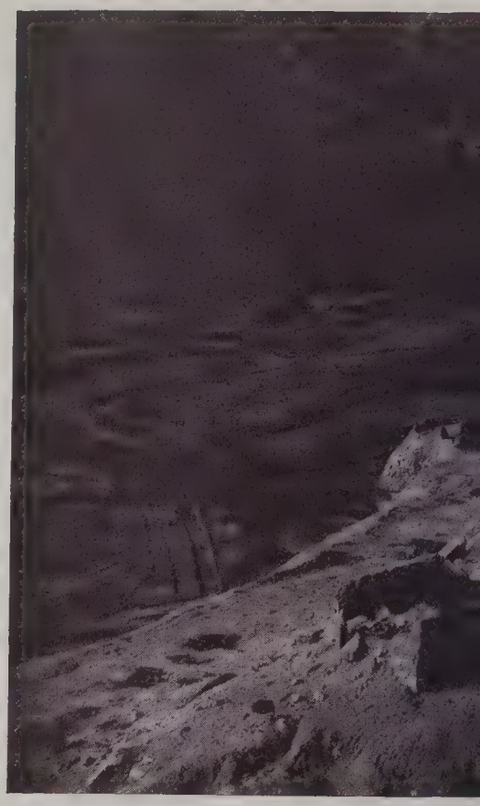
By WALTER A. FAIRSERVIS, JR.*
Special Field Assistant,
Department of Anthropology,
American Museum of Natural History

Exploring the "Deser

AN expedition is born of an idea, which in turn is begot from study. In this case the study was on the lands of Central Asia; the idea was that ancient man made his home there as well as on the Euphrates and Nile. The expedition took us to Afghanistan—beyond Khyber Pass—and revealed to our searching eyes the traces of mankind from the Ice Age to the days of the Crusades and the glories of the Peacock Throne. Our work took us into secluded grottoes, rich valleys of melons and grapes, and great deserts as remote from human knowledge as the planet Pluto. We saw the marks of mountain ice, great Buddhas carved in cliffs, strange signs on rock, the mound vestiges of prehistoric villages, the signs of ancient seas, ferns from the age of the dinosaurs, and a great city without a soul, mourning the past glories of Solomon and Afrasiyab.

The prosperous interior cities of Asia—Herat, Kandahar, Meshed, Ispahan—form a crescent enclosing a chain of deserts that are utterly removed from our world. Each desert has a name that explains something of the fate of the trader or soldier who ventured too far from the watered zones—the Dasht-i-Kavir ("Desert of Salt"), Dasht-i-Naumed ("Desert of Despair"), Dasht-i-Margo ("Desert of Death"), etc. Moistureless, cloudless, swept by winds of high velocity, and baked during an endless summer by temperatures many degrees above 100 F., a more severe bound and brake to human ambition is hard to imagine.

The red plateau of Registan marks



▲ BETWEEN THE TOWERING slopes of
tral Hindu Kush, the Bamiyan Valley
many interesting vestiges of earlier

Photo by L. B. Dupree

▲ THE BUDDHIST grottoes of Bamiyan. The people who created them were fugitives who sought refuge here from persecution in India

*WALTER A. FAIRSERVIS, JR. is the son of Edith Yaeger (Fairservis), one-time leading lady in the theater. He has worked in archaeology in one way or another since the age of nine, when he first entered the halls of the American Museum of Natural History. Mr. Fairservis received his B.A. and M.A. from Columbia University and is at present a candidate for a Ph.D. at Harvard. While he was on military service in

Photo by Fairservis

ew was taken from the fortress of Shahr-, said to have been destroyed by Genghis the thirteenth century

! Death"

the eastern end of this haunted chain of aridity. Across it the wind blows monotonously from the west and northwest, and the air is hot and parching. Yet a river breaks into the desert chain here. The Helmand, flowing from the western branch of the Hindu Kush, cuts south between Registan and the "Desert of Death" and then turns west and north to die in the swamp of the Seistan basin, on the boundary between the Afghan and Persian deserts.

Mongolia, China, and Japan, he studied the languages of the Far East; and he recovered one of the skulls of *Homo soloensis* from the Japanese and returned it to Dr. G. H. R. von Koenigswald. Mr. Fairservis is a Special Field Assistant in the Department of Anthropology at the American Museum, and he expects to depart soon on an expedition to Central Asia to continue his archaeological research.—Ed.

Photo by L. B. Dupree

▲ The great Buddha of Bamiyan: a 130-foot statue carved in the hard rock of a breccia cliff. The valley in which this and other similiar statues are found is almost 100 miles west of Khyber Pass

▼ A member of the expedition rests on the shores of the Helmand River

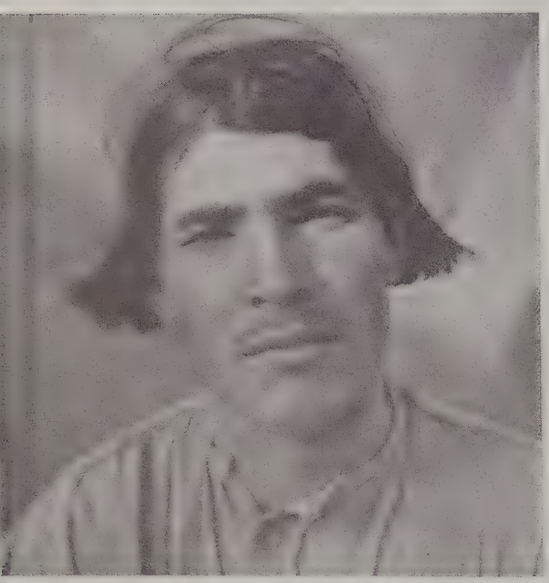
Photo by Fairservis

Photo by Fairservis

This is a stream capable of upholding life along its narrow, fertile valley and at its mouth, the oasis—Seistan. Nile, Euphrates, Helmand—rivers like these, flowing through deserts, are the sole support for the people of vast regions that would otherwise be uninhabitable. The way in which a culture utilizes this essential resource of water determines the heights to which it can progress. We know very little of the Helmand, but in view of the cultures of India and the Near East we should know more.

It was with the intent to study this region that I approached Dr. Harry L. Shapiro of the Department of Anthropology at the American Museum of Natural History. I wanted to take a field party to southern Afghanistan to search for the sites of prehistoric man, which in theory should be there. Dr. Shapiro was in full sympathy with the program; and after a small fund had been raised, I left for Afghanistan with two companions—Louis B. Dupree, paleolithic archaeologist, and Henry Hart, surveyor. We met our equipment in Karachi, Pakistan, and began the thousand-mile journey to the north by way of Multan, Lahore, Peshawar, and the Khyber to Kabul, the capital of Afghanistan.

From the first, the expedition seemed shadowed by ill fortune. We had hardly gotten eighteen miles from Karachi when we found



➤ AN AFGHAN TYPE: a hardy man over six feet tall and an excellent worker

➤ AFGHAN WORKERS relaxing in the middle of the day. They are working for an American engineering company at Kajakai, in the Middle Helmand Valley

➤ THE CRUMBLING TOWERS of an old fort stand silhouetted against the flat river bottom that has seen armies come and go. Another view from the heights of Shahr-i-Zohak in the Bamiyan Valley

➤ UNDECIPHERED PETROGRAPHS like these are seen along the road from Kabul to Bamiyan

Photo by L. B. Dupree

our way blocked by one of the monsoon-swollen branches of the Indus at its delta on the Arabian Sea. Fully four-fifths of the way across, the swirling water was knee-high. The last fifth, where the full anger of the flood was thundering its rage, it was waist-high! There was no other crossing, so the whole project hinged on our getting the vehicles through. If the equipment were swept down the river, there would be no expedition. I imagined myself wiring to Dr. Shapiro: "Expedition ended eighteen miles outside of Karachi!"

Photos by L. B. Dupree

➤ AN AFGHAN "MILTON BERLE," who, like others of his kind, was always able to restore the expedition's sense of humor

Photo by L. B. Dupree

➤ ONE OF THE MANY mounds containing artifacts of prehistoric peoples, which the author hopes to explore further on his coming expedition

Photo by Fairservis

A motor lorry on the opposite side finally braved the flood and, with half the local population pushing, got across to us. Near by, some Pakistan farmers were trying desperately to save some cattle that were struggling in the flood. I hoped, however, that the weight of our equipment and the jeep's four-wheel drive would save the day, and so we tried. In low-low, the jeep and its trailer reached midstream, with three Americans and an English ally muttering words of encouragement as if the car were a college gridiron squad. But in midstream she stuck! Our combined efforts were useless, and for all practical purposes the First Afghan Expedition was the Last! But the local populace suddenly thrashed through the water, and wherever there was a place to push or pull, they did so. In fifteen minutes we were roaring along the desert road through the Sind on our way to Kabul.

In spite of daily tire difficulties, mechanical failures, and the monsoon, a week later we were winding along the tortuous route of Khyber Pass, about which so much has been written and so little of the real feeling conveyed. And then there was that indefinable moment of excitement when the gate at the frontier was opened and we drove into Afghanistan.

Our Western conception of the country fills it with bloodthirsty fellows who love destruction and make a career of brigandage. Yet how mistaken that conception is! We can only testify to the wonderful way we were treated on every hand. Minister of Education Aziz, though seriously ill, put every convenience at our disposal, and Mr. Ahmad Ali Kohzad, the President of the Kabul Museum, went out of his way to see that our stay was profitable. His keen interest in science was inspiring. Other high Afghan officials aided where they could. In Washington, the Afghan Ambassador, H. E. Prince Naim, was instrumental in bringing about our project, and the First Secretary, Mr. Nour A. Etemadi, was extremely understanding of our problems.

The same courteous sympathy was generally evident among the Afghan people. Proud as they are of their unconquered tradition and also filled with a not unreasonable distrust of the Westerner, they nevertheless get along very well with Americans everywhere. The Morrison-Knudsen Company, Inc., of Afghanistan, an American engineering firm under contract to the Afghan Government, has been their

Photo by L. B. Dupree

▲ A FRIENDLY AFGHAN who found humor in everything

▲ THE VEHICLE THAT carried the expedition across 8000 miles of desert and mo tain. A typical scene at Seistan, a desolate district in southwestern Afghani

Photos by Fair

▲ A CARAVAN in an Afghan village on the road to Seistan

major source of contact with Americans. Afghans are employed in the construction camps, and Americans are now no novelty in the cities. There is every chance of friction, yet cases of it are rare.

We were helped voluntarily on many occasions both by the Afghan lorry drivers and the people of the fields. Strongly Moslem as these people are, they never let religious feeling interfere with their good treatment of us. I do not mean to gloss over the Afghans with fine words as if the country were some Asian Eden. We had difficulties, of course, with thieves, malcontents, etc., but no more than we would have had in the United States. Under the country's absolute but progressive administration, Afghanistan is rapidly taking a place in the Asiatic world, which will have to be reckoned with by all nations in the scheme of world affairs.

Kabul is a fast-growing city with paved streets, electric power, and plumbing. Set in a beautiful mountain valley, it is surrounded closely by high hills on which the ruins of old forts can be seen. Indications of Afghan progress are seen in the strings of lights that have been placed on these hills, ringing the city with their illumination. Approaching Kabul at night, which one usually has to do in the long drive from Peshawar or Kandahar, the glimpses of this "necklace" around Afghanistan's new "city of light" are rather breath-taking.

The peoples one encounters in Kabul clearly indicate Afghanistan's position at the crossroads of Central Asia. Mongolic Hazara, Turkic Uzbeg, Persians, and Baluchi mingle with the Kabulese. The Pathan peoples of eastern Afghanistan, who are there in large number, have been written of too often to repeat the description here, but a glimpse of their tall figure, stern face, straight nose, and piercing black eyes is sufficient to give one a hint of the spirit that has kept their mountain homes inviolate over so many centuries.

Afghanistan economy is primarily agricultural, heavily supplemented by animal husbandry. The melons and grapes of the Kandahar region are justly famous and are of high quality. The number of "fat-tailed" sheep is amazing, and it is quite ludicrous to see these unusual animals waddling hurriedly across the road with their fatty hind appendage acting as a brake to their progress. Long-haired goats mingle with the sheep, and their browns and blacks are quite striking. Camels are seen in great abundance, and no matter what the temperature or the hour, the sight of their flopping lower lip, disconsolate eyes, "cloth" ears, and rather inarticulate body restores one's sense of humor instantly.

Whereas in the past Afghan agriculture has been limited to a few crops, recent emphasis on land reclamation through irrigation has instigated experimentation. The possibilities of growing a major staple crop such as cotton are very good, and a gradual revolution in Afghan economy could well take place with the irrigation of these hitherto arid lands.

After final arrangements had been made, our expedition set out for the Helmand Valley and the beginning of our intended task. The route we followed out of the mountains was a very ancient one, an alternate road to India via Ghazni, Kandahar, and ultimately the Bolan Pass of Baluchistan. However, at Kandahar we went westward toward Girishk instead of south to Quetta in Baluchistan. On the evening of our second day from Kabul we had reached the river and proceeded south on its western bank until our progress was blocked by the dunes

Photos by Fairservis

SSIBLY AN ANCIENT granary in Seistan. It resembles a lean sacred tower, though it is 1000 miles distant

▲ BEEHIVE-SHAPED HOUSES on the Perso-Afghan frontier near Lake Seistan

and wadis of the Dasht-i-Margo.

The Helmand at Girishk is several hundred feet wide in summer but at least three times that in spring. The valley it has carved out is several miles wide in places. South of Girishk, the people live down along the flood plain, most of which is irrigated or covered with tamarisk. This flood plain abuts against the boulder-conglomerate bluffs of the desert, and we had to travel on these bluffs because of the brush and irrigation ditches on the flood plain. The high wind that blows from the west across the desert has blown out the sand of the surface, leaving only the large boulders. They are almost cemented into position by chemical and thermal action and present an exceedingly hard surface of black pebbles. This is the process known as "armoring the desert," and, in fact, it would take the best of modern equipment to crack this natural armor. Our vehicles ran smoothly over this surface at speeds up to 50 miles per hour without difficulty. Ancient erosion, however, has carved ravines, or wadis, out of the desert. The sand has found refuge in these, and each system constitutes a trap of the worst sort for the unwary driver.

Trying to get a vehicle out of one of these traps is a nightmare worthy of a Poe or a de Quincey. The wadi's walls prevent the wind from cooling one's body, and the direct rays of the sun, unbroken by clouds or haze, pour mercilessly on the men working to free the vehicle. On one occasion it took us four hours in the heat of the day to get free of an innocent-looking patch of white sand. Four-wheel drive, bracing, canvas, wood flooring, etc., were of no avail; only the combination of shoveling and ardent pushing did the trick. Being far from gasoline sources, we could not afford to skirt the many miles of wadis, so in order to stay within range of the river we were exploring we had to take certain risks in crossing them.

These ancient river systems, in carving out their pseudo basins, have left high walls and bluffs in places. As the desert horizon is usually almost mathematically level, seeing these bluffs is a definite relief. On one occasion we had with us an Afghan boy, Olam Nabi, who spoke three languages: Pushtu, Persian, and Baluchi. He had been extremely helpful, especially in gathering fresh fruit and eggs for us. As we were driving south one day, he pointed to the west where the vast expanse of the waterless waste of the "Margo" spread its heated surface. To our amazed eyes we seemed to be gazing at the walls of a great city, beyond which could be seen towers and buildings. The nearer we approached, the more our first glance was confirmed. Suddenly we all recognized the "city" for what it was—simply the bluffs of our well-known wadi-basin system. It was neither a mirage nor a trick of the mind, but our eyes, so accustomed to the monotonous horizontal, had conjured up dwellings when the horizontal was broken.

Our survey along the river confirmed the belief that this part of Central Asia had been unglaciated during the Ice Age. For this reason, it may well have been a haven for ancient man. The mountains that prevent the Indian monsoon from bringing moisture to southern Afghanistan must have performed the same function during the Ice Age, with the result that the unnourished mountain glaciers could not have devoured the lands to the south. The extent to which ancient man utilized this ice-free area is as yet uncertain, since we found no actual artifacts. However, future search of the region should confirm his traces—traces that were only hinted at in this first brief survey.

Just before our departure from Afghanistan we were told by Mr. Morris Brown, an engineer, that there was a valley near Kajakai, in the foothills of the Koh-i-Baba, whose rocky slopes were covered with strange pictures of animals and figures. We were naturally eager to visit this place. After swimming the Helmand and climbing through a break in the cliffs, we entered a narrow valley several hundred yards in length. One glance confirmed Mr. Brown's description. Not only were there numerous animal and human figures but a wealth of strange, undecipherable signs as well—checkerboards, human hands, loops and circles, and even a figure that suggested nothing other than an octopus! These were pecked out of the rock in no particular order. Many of them were exactly like those seen by the Russians in the Pamirs. We had also seen similar ones on the road to Bamiyan, the ancient center of worship in Buddhist times. As to who made these drawings, and when and why, we have no answers as yet. Petroglyphs have been cut by man in extremely remote antiquity and carried over into modern times. Many of the ani-

mal drawings were probably made to bring success in hunting. A high percentage of signs were probably used as amuletic devices or cabalistic tokens. The similarity of some of them to certain ancient alphabetical symbols may aid us in understanding these glyph-pictures, as will their relation to conventional art forms and religious symbols.

Having completed our reconnaissance along the middle Helmand, we proceeded into the Seistan region of Afghanistan, which lies along and over the frontier of Persia. We set out along the foothills of the Koh-i-Baba and headed westward. Approaching the Persian frontier, we turned south of the main route at the cool tree-studded city of Farah. The road, an old one that led from Herat into Seistan, is now used by occasional motor lorries en route to Chakansur.

We passed our first night in Seistan on a bank beside this road, where a low mud wall provided protection from the northwest wind. As we proceeded southward, the wind seemed to increase in violence until "puffs" of 60 miles per hour were a daily occurrence. This is the famed "Wind of 120 days," which starts in May and blows well into September. Velocities up to 110 miles an hour were recorded by the British on the Perso-Afghan Boundary Commission around the turn of the century, and at no time did we encounter a velocity of less than 20 miles per hour. The wind is a curse and a blessing at the same time, for the temperature of the day becomes almost unbearable, varying from 105 degrees F. to as much as 125 or 130! This makes the ground so hot that at night the thermometer rarely falls below 75 degrees. The wind, however, by drying perspiration, makes these temperatures somewhat more tolerable, even though quantities of sand are whipped up constantly and the tiny grains penetrate everything, whether it be carburetor or eye.

In spite of such discomforts, the trip into the Seistan basin was most profitable. At every hand we encountered evidences of archaeological interest. Over 35 mounds, or *tells*, were located, and surface collections were made at most of these. Our laboratory studies have since revealed pottery fragments of the prehistoric period, enabling us to date a number of sites as belonging to that period. Excavation of some of these sites is planned for the coming season, and much significant material should be recovered. Thus, our primary objective in entering Afghanistan was achieved in a way that was most gratifying.

One blazing-hot September day we were amazed to see the ruins of a large city on the horizon. It might seem impossible to encounter such a thing in the desert, but the ruins continued for nearly six and a half miles! Drawing closer, we saw the remains of palaces, mosques, and homes. The wall that had protected the city was in some places in a startling state of preservation; in others it was in complete ruin. The reader may recall having read of this "Ghost City" in the newspaper accounts of our expedition—a desert metropolis standing mute just as it had for six centuries or so since its abandonment, undisturbed except for the ravages of time.

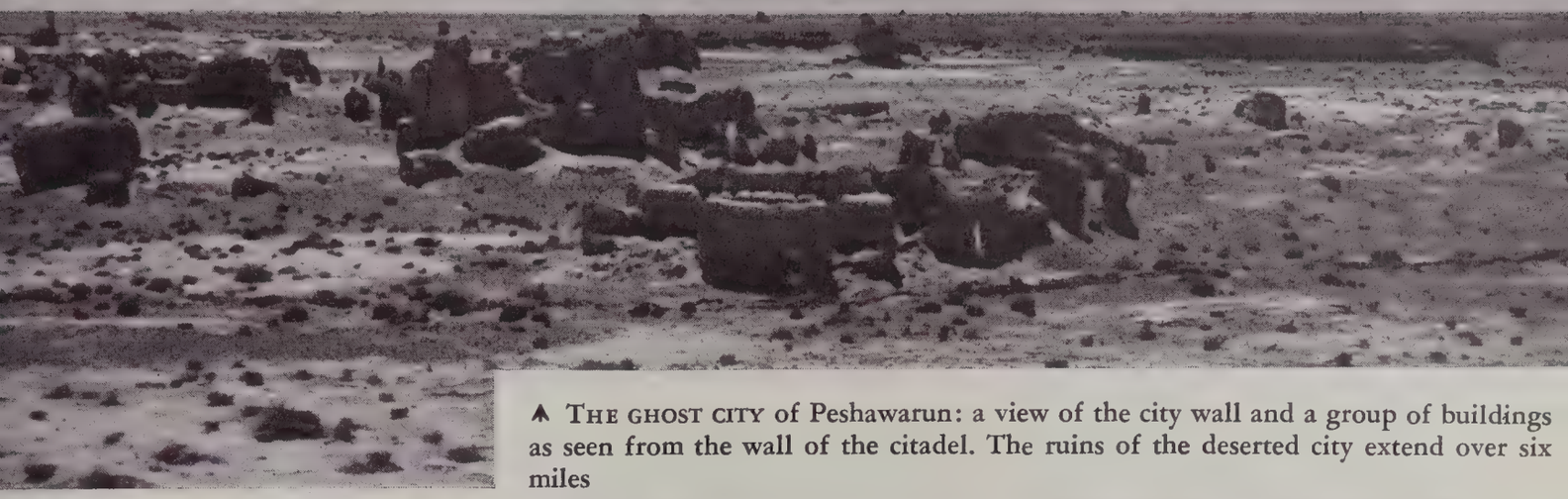
We knew from the works of Sir Frederic Goldschmidt, A. H. McMahon, Ellsworth Huntington, Sir Aurel Stein, and others that Seistan was literally covered with the ruined cities of the Medieval Islamic period (A.D. 1000-1500), as well as earlier sites. Many of these cities, such as Zaranj and Neh, were of some importance during the "Golden Age" of Islam. This one—Peshawarun—some 40 miles south of Juwain, had been mentioned in various reports but never fully described.

Our program did not permit us to devote time to Islamic studies, but we could not pull ourselves away from these ruins, so well preserved were they and so dramatically eloquent of the effects of climate on a city. Failure of the water supply seemed a logical explanation of the fairly sudden abandonment of Peshawarun. We found wells of considerable depth bone-dry.

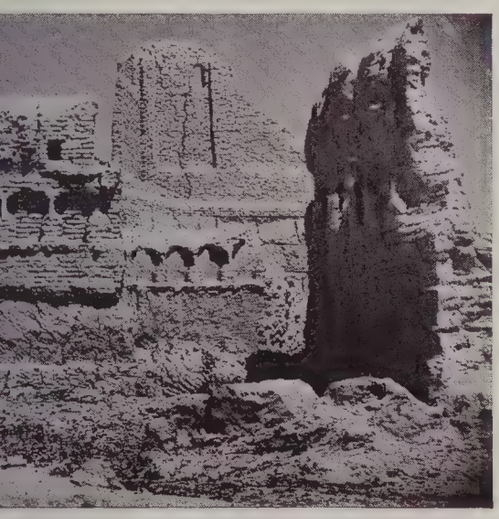
To drive between the walls of great buildings to the base of the fortress that dominated the town and to see not a living soul was an exceedingly strange experience. Everywhere there were signs of extensive irrigation, showing that the land had once been highly cultivated. In fact, from the size of the buildings and the extent of the city area there can be no doubt that Peshawarun must have been an important center and the home of a considerable population. The records we have seen tell us nothing of its history. There is a local legend that when Tamerlane punished Seistan, he destroyed the wells and thus forced the populace to flee over the deserts and mountains to found the modern city of Peshawar at the eastern head of Khyber Pass. There is no evidence either for or against the legend, but it should be recalled that a great percentage of Eastern disasters are attributed to either Genghis Khan or Tamerlane without historical confirmation.

Whatever effect Tamerlane may have had on the city, the fact remains that Peshawarun was never reoccupied. However, there is a small native village only a few miles away, where water is drawn from a well over 60 feet deep. One immediately wonders whether something caused the water table to lower so much that occupation of the city could not continue. Even if there had been conquest or plague, it is difficult to imagine a large populace giving up a fertile area completely and permanently when such areas are at a premium. I believe the answer lies in the antics of the Helmand River, which, in flowing into a shallow basin delta, changes its course at will. Movements of this sort affect the level of underground water, and thus the cause may be partly physiographic. But the Helmand shift can be due to numerous causes, and especially important may be rain failure in the Koh-i-Baba.

Whatever the cause of the city's abandonment, there is something pointed up in Seistan that is more significant than the story of a single city of the Islamic period. Seistan presents a forceful picture of the effects of geography on the workings of man. When nature forces



▲ THE GHOST CITY of Peshawarun: a view of the city wall and a group of buildings as seen from the wall of the citadel. The ruins of the deserted city extend over six miles



ONCE AN IMPERIAL PALACE, now a symbol of Peshawarun's vanished splendor

▲ WHEN PESHAWARUN was a thriving desert metropolis, the sound of commerce and government echoed in these arches, now half buried

Photos by L. B. Dupree

▲ A RUINED ARCHWAY in the citadel wall at Peshawarun

◀ ANOTHER VIEW of the ancient palace at Peshawarun

man to do something, it may come as a shock to the psychology-permeated cultural anthropologists of the present day, who would hitch so much to the multifaceted personality of *Homo sapiens.* Migratory studies are of vital importance if we are to perceive the workings of history as well as some of the mechanics of cultural diffusion. In Central Asia the effects of desiccation are extraordinarily clear, and the need for the proper approach to this problem of man and nature and his culture is very great. As yet, we can only guess at the factors concerned.

Central Asia forms a huge stage on which lie the clues to many aspects of mankind's ancient past. Out of its desert lands have come some of the greatest intellectual and spiritual developments in all history. Perhaps on this stage the clues to be found in lands like Afghanistan will crystallize still more for us the drama of our heritage of conscience as well as of culture.

In June we leave again for Afghanistan to search further into these unknowns.

Cherished U

By canoe and snowshoe in a primeval wonderlan

"BUT of all the wildernesses that you know," people say to us, "you cherish most your canoe country. *Why* do you love it most? Why have these friends you speak of been willing to give years, sometimes their entire lives, to preserve its wildness?"

I will try to answer those questions.

First, we, and many many others, love this canoe country because it is truly a solitude. It is not overrun with people as are many of the accessible wilderness areas. Instead of a few roads or trails on which you must meet all visitors, you may travel in your canoe in any direction, and yet you do not need a guide—only a good map. So you have the joy of seeing a true wilderness with utter freedom.

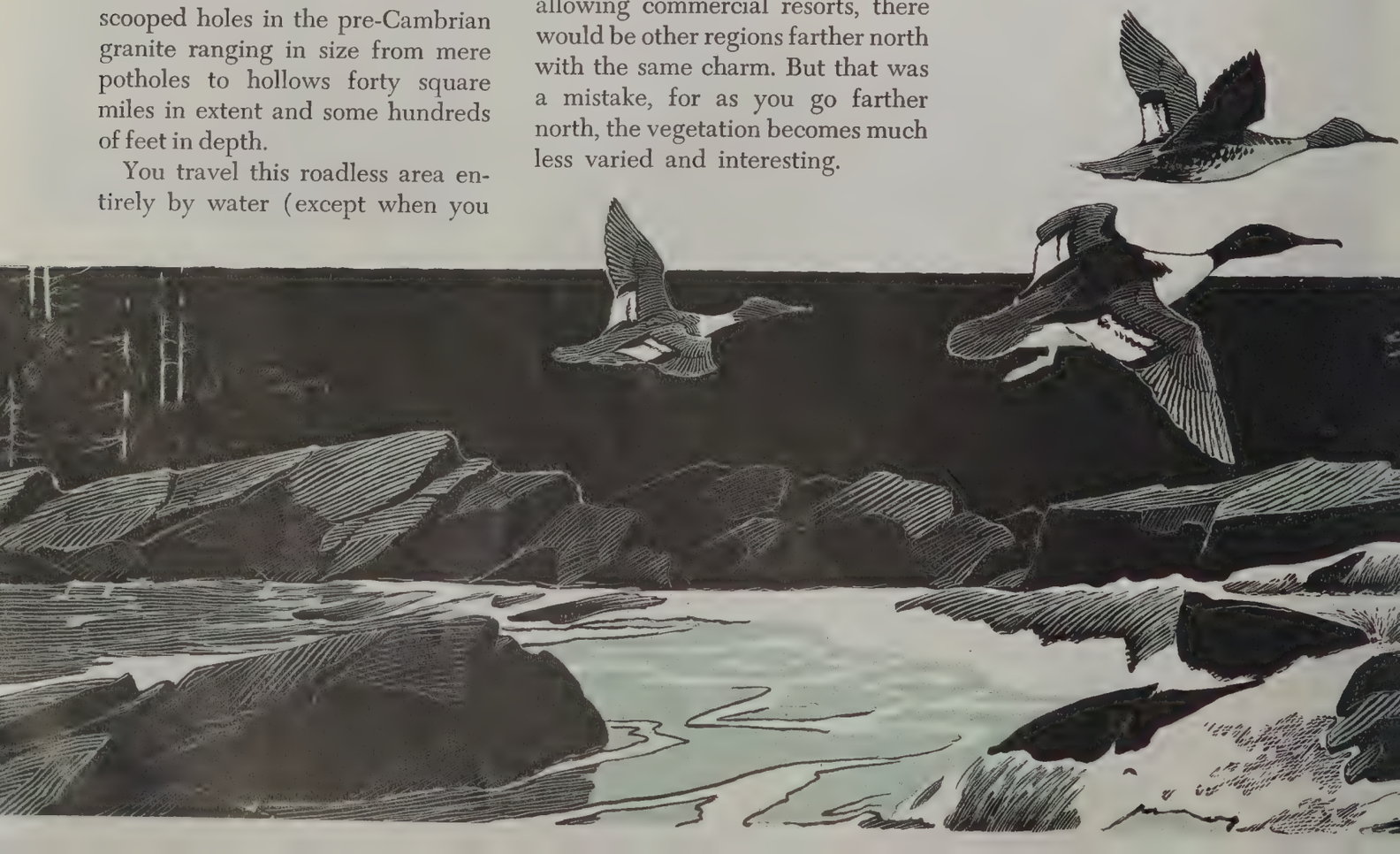
This area, the Quetico-Superior, lies on the borders of Minnesota and Ontario, between Lake Superior and the Lake of the Woods. It is hardly limited in space, being about 175 miles long and containing around 16,000 square miles. It is a maze, a labyrinth of countless lakes, tied together by rivers and channels—in fact, 40 per cent of the surface of this land is covered by water. These lakes were made in the recent Ice Age by glaciers more than a mile thick. Those mammoth bulldozers scooped holes in the pre-Cambrian granite ranging in size from mere potholes to hollows forty square miles in extent and some hundreds of feet in depth.

You travel this roadless area entirely by water (except when you make a portage) just as the earliest travelers did. Airplanes will soon be banned from flying over the area, to the great relief of its devotees, so that there will be no danger of finding the ancient peace shattered by a sudden onslaught of the motorized era! It is practically uninhabited, and as you journey through it, it looks as it did to the Indians and voyagers in the early days. It is possible to canoe for days without seeing other campers.

In the second place, we love the region for its sheer beauty. To enter it is to enter a forest realm of unspoiled loveliness. With lake after lake of blue lucidity, it does not matter where you choose your way, for a fresh beauty is everywhere. And such diversified beauty! I once thought that if this country were spoiled by changing water levels or allowing commercial resorts, there would be other regions farther north with the same charm. But that was a mistake, for as you go farther north, the vegetation becomes much less varied and interesting.

Here are lakes of purest clarity, streams quiet or wild with white water. Here are forests of pine, of spruce, of aspen, birch, and other hardwoods. Great granite cliffs, deep in moss and ferns, tower above, and marshes stand thick with reeds and wild rice. Here are bare, stony hills, rapids that rush by shadowed ledges, sandy beaches. Here, best of all, are hundreds and hundreds of big and little islands. Once the tops of craggy hills, they are survivors of the Ice Age—low ones of smooth-washed stone, and rocky heights black with pine.

And it is just as inspiring to the other senses, all of which seem suddenly to awaken. As you take a portage trail through the dense spruce, you are vividly, not dimly, aware of its resilience underfoot, of the scent of the pungent sweet gale leaves,



derness

ture lover will want to see preserved—

ne Quetico-Superior area, whose beauty hangs in the conservation balance

By FLORENCE PAGE JAQUES *Illustrated by* FRANCIS LEE JAQUES*

and the poignant song of the hermit thrush, while at the end of the trail you may be refreshed by the taste of the clear water you dip from any lake or stream.

Memory brings back the smell of campfire smoke, sun-warmed pines, and damp muskeg; the taste of bass, freshly caught; the sound of a deer's whistle or the slow plunge as a moose leaves the water, and the never-forgotten loon call.

The greatest boon of all, however, is to listen to the profound silence. You cannot realize how frail most silence is until you experience this, so deep that you can trust your whole being to it, sure of its strength.

Then there is the enjoyment of physical effort. The mere breathing of the stainless, heady air; the exhilaration of paddling, drifting down glassy water or fighting furiously against a head wind. Because of the rocky terrain, making camp is seldom difficult, for there are innumerable sites to choose from. Portages are most enjoyable, if they are short ones and if you make them easy by walking across two or three times instead of lugging everything at once. The shadowy walk itself is a welcome change after the hot sun or boisterous wind over the water—if you aren't staggering under too heavy a load. Fishing is excellent in many of the lakes.

All these experiences we savor to their full because of the way we travel here. We are all dashing through the present world so fast we scarcely have time to see it. But in these primitive fastnesses all our senses have a chance to come fully into play.

I have to admit to a naive astonishment when I discovered that this country had as great beauty in winter. After our *Canoe Country* was published, the University of Minnesota Press gave us a fellowship so that we could get the material for *Snowshoe Country*. We were to stay in the same territory in the winter-

*FLORENCE PAGE AND FRANCIS LEE JAQUES hardly need an introduction to the readers of NATURAL HISTORY, for many of their interesting and beautifully illustrated books have been reviewed in this magazine. *Birds Across the Sky*, *Canadian Spring*, and *The Geese Fly High* were written by Mrs. Jaques and illustrated by Mr. Jaques. In 1946, they were jointly the recipients of the John Burroughs Medal.

Mr. Jaques, one of the world's most distinguished bird artists, worked at The American Museum for many years, where he painted many outstanding panoramic backgrounds. He has accompanied expeditions to the Arctic, the Polynesian Islands, Panama, and the Bahamas.—ED.

time. Because I had always dreaded cold weather, I was simply horrified at our good fortune.

I never once thought of refusing it, but I expected the worst. It was, however, one of the most rewarding experiences I ever had, and I would do it again any time I had the chance. Of course, we didn't camp; we stayed in a small cabin on the edge of the roadless area. To my surprise, a small stove made from an oil drum kept us perfectly warm indoors, blizzard or no, and I found that, dressed in layers of wool, I was more comfortable outdoors in 30-below-zero weather than I had sometimes felt on a sticky August day. I even found that in my ski suit I could rest, lying in a snowdrift, while I watched a pine grosbeak sing or a shrew dart hither and thither, and feel as much at ease as if I lay on a sand dune. For a while, at least.

And the glory all about us was unbelievable. Deep snow covers the country the entire winter. I had thought there might be a monotony about such a continually white landscape, but it was never just white. There was a continual play of color about us. The apple-green skies might reflect in the frozen lakes, or a bright sun would change the shadows on the snow to vivid blue or strong violet. Evening light might touch the snowy hills with gold and the morning with clear shell-pink or lavender. We had stormy sunsets of scarlet and purple beyond snowy pines, and we had northern lights of such strange hues I could not recognize them. Hoarfrost might be so thick upon the scraggly aspens in the morning that they looked all aflower with silver. I had thought that if the winter dragged we could always escape to Duluth for a few days; I never even remembered that idea after we were in our cabin.

The winter sounds I remember even more distinctly – the deep clangs, like those from an enormous gong, which the lake gave, and the crack of branches in the coldest weather, and the uproar the sled dogs made late at night when a wolf or a fox barked. Whenever I now hear the spring song of the chickadee–those two little notes like a miniature phoebe's–I think of a warm January day on the Gunflint Trail. And there is the faint *shushh* when a drift of snow slips from the laden branches of a spruce. I sometimes put myself to sleep remembering the nights when we walked on snowshoes along the trail before we went to bed; there would be that *shushh,* and then a deer might bound across before us in the dim snow light and disappear in the black forest. Yes, we appreciated the country in winter, too.

But most of all, I am sure, we love the canoe country for the release it brings us from our complex modern existence. This is not an escape from reality–in fact, it is an awakening to what *is* reality. The canoe country gives us the joy that should be man's heritage.

We are released from possessions. And how exultant we feel when we arrive at this simplicity–to start off in a fragile shell (for a canoe is the most trifling barrier from nature imaginable) with all our worldly goods in a few packsacks, with no need for immense mechanisms or complicated contrivances to aid us on our way, with only sturdy paddles in our hands.

We are released from time. Imagine having no need for a watch, having no appointments or schedules. There is no hurry, for as each square mile of the many thousands is rich in interest, why rush anywhere? On the other hand, if we have a desire to wander, we do not need to wait for a train or a boat to start or a gas station to open.

Suppose we have had a lazy, rain-bound day and have gone to sleep in our sleeping bags immediately after an early supper. Suppose we awake sometime long after midnight to find that a full moon is flooding the lake with brilliance and that fantastic pine shadows lie black on the shore beyond our small tent. There is nothing to prevent us from breaking camp and starting out through the night into a silvery and silent world. So silent that we not only do not talk but put our paddles into the shining water with meticulous care. The moon leads us on, pines stand jet-black in mysterious ranks on either shore. What eyes are looking at us from those inky depths? Far off we hear the hooting of a great horned owl.

We come to a moonlit river, where white stones gleam in faintly rippled water and bulrushes look as if they had been dipped in quicksilver. Something slips away down the water, leaving a sharp-drawn wake. Then we come to a density of overhanging branches where the night lurks blackest.

As we emerge into another wide lake, there is a hint of dawn in the eastern sky, and we watch as the faint rose light gradually gains victory over the silver. We hear a single whitethroat, then silence and darkness again. After an interval, a loon laughing wildly somewhere down the lake brings the true dawn. We find that we are ravenously hungry and stop on an island for a hearty breakfast among its jack pines.

Or we may be intent on reaching a river where we hope we may find moose. But when we come to a crescent of sand beach, why not see what tracks are there? And while we're there, why not go swimming? So we do. Then we decide to fish, after which we climb on clean mats of pine needles to a hilltop for lunch and decide it is too delightful a day not to swim again, so we make camp, even if it is only early afternoon. We may spend several days there, or we may go on to the moose river early the next morning. No one minds.

We are released, too, into a wider acceptance of companionship, when, as Wordsworth says,

With an eye made quiet by the power
Of harmony and the deep power of joy,
We see into the life of things.

We discover ties of comradeship with the animals and birds, even the plants that share this region equally with us. Here they are not under tolerance. This is their land. They have as much right as we, or more, to this domain.

So when we make camp under the horizontal branches of a white pine, we feel a companionship with it. In an unexpected October storm

the scarlet of bunchberries through the snow has seemed as warm a welcome as children might give us. And we hail the deer we encounter, the flocks of young mergansers, the exuberant pileated woodpecker, as long-loved friends. To my surprise, I become very fond of porcupines. Somehow a porcupine swimming is a rather touching sight, and when I see a small one eating leaves and swinging gaily in a thrashing treetop, I almost want to join him. Even more surprising is to begin to care for wood mice, who are really entrancing neighbors though they may annoy you.

I never think of being isolated here. I feel the release from the heavy weight humanity now carries, rather than loneliness. How could we be lonely? We meet new friends all the time.

Once I was lucky enough to see the purple finch giving his courtship dance. I had not known that a small songbird gave such a performance. In his vibrating intensity, he would have equaled the birds of paradise we once saw in their courtship at the zoo—if his feathers had been as long! Clad in brilliant rose, he danced up and down a small log before his ladylove. He turned about and about, with his crest high, raising his wings and quivering them so rapidly that they blurred into rosy radiance. Then he sprang into the air and sang in flight as if he were trying to be a rose-red skylark, before he returned to dance on the log once more.

Another morning two loons permitted us to drift up to them, until we were hardly more than a paddle's length away. We were highly flattered, but we couldn't understand why such wild birds as loons would continue to let us float in company with them. We were so close we could see every detail of their black-and-white plumage, even the clear red iris of their eyes. Finally Lee spotted their nest on a hummock in the marsh close at hand, and we understood their lingering.

I treasure the memory of an autumn day when we were exploring along a shore. Golden aspens were reflected so perfectly in the dark water that we seemed enclosed in a spangled net, and I felt bewitched, as if our canoe were floating in the air in the center of this gold shimmer. To add to the strangeness, when we came round a point of rock and saw a bear facing us, it made no effort to run away as a bear should.

To look straight into the eyes of a black bear a few yards away is an odd experience. The bear gave no start of alarm and neither did we, but there was not the accord one feels with a deer in such a situation. For a moment before the deer realizes that you may be a menace, there is an inexplicable bond as its eyes encounter yours. There is no such bond with a bear! Its look changed from curiosity to disdain, and my look, if not Lee's, to apprehension, as the animal shifted feet before leisurely strolling off into the thick bushes.

Then there was the day when we had battled across a wind-tossed, white-capped lake and, tired but triumphant, came into a cove. As we floated up to shore, we saw a spotted sandpiper with her two minute babies, probably just hatched. She ran for shelter, calling peremptorily. One baby was an old-fashioned infant and obeyed mother instantly, but the other, a modern child, paid no attention to her stern command. It came out to the shore to look us over, living up to its family nickname by teetering its nonexistent tail. Such a scrap of life; but it met us on equal terms. We felt we had been congratulated on our safe arrival by a reception committee of one, and we appreciated the courtesy.

These are some of the reasons why we have such a passionate desire to see this region kept unspoiled. It is a unique treasure which we trust fervently may be preserved for the generations to come. If I could save any part of our physical heritage unchanged, it would be the woods and waters of the Quetico-Superior. For ever since I first went there, whenever I chance to think of our canoe country, an inexpressible delight and peace flood through me in a great tide.

An Electric

IN

A strange cold "fire" seeme descend on the region, and a time every bush became lu nous beneath the lurid storm

IN early September of 1949 I had occasion to drive from Madison Junction to Mammoth Hot Springs in the Yellowstone Park, and dusk was gathering when I drove onto the stretch of straight highway that parallels Swan Lake. A violent electrical storm was centered over Electric Peak, extending several miles eastward into the Beartooth Range. Heavy bolts of lightning frequently stabbed downward, and the clouds themselves seemed to be constantly flickering with an orange light. The display was so spectacular that I pulled off the road near the north end of Swan Lake and stepped out of the car to watch it.

It was then that I noticed a bluish light coming from over the low ridge to the west of Swan Lake. My first thought was of a fire, perhaps caused by lightning. I watched the ridge for a moment and was amazed to see what can best be described as a hazy patch of blue light coming over the ridge and moving down the hill slope toward the flats around the lake. It was then that I observed a very low lead-gray cloud moving swiftly above the patch of light. The patch moved through the marshy north end of Swan Lake and caused several waterfowl to rise in hurried flight.

The patch of light moved off the

Bath" IN YELLOWSTONE

By
WILLIAM B. SANBORN
Park Ranger Naturalist

Photo by David de L. Condon

▲ SWAN LAKE, across which the electrical display moved before passing up the valley toward Electric Peak, in the background

lake and onto the flats at a steady rate and proceeded directly toward my viewpoint. When the patch was but a few yards away, I noted a sudden calm in the air and a marked change in temperature, as well as what I believe was the odor of ozone. It was then that I realized that the display before me was some manner of static electricity, comparable perhaps to St. Elmo's fire and directly controlled by the low cloud moving above.

The patch, which actually was a static field, enveloped my immediate area. To describe the weird feeling caused by viewing the progress of this phenomenon is difficult. It kept low to the ground, actually "flowing around" everything that it came in contact with, coating it with a strange pulsating light. Each twig on the sagebrush was surrounded by a halo of light about two inches in diameter. It covered the automobile and my person but did not cover my skin. There was a marked tingling sensation in my scalp, and brushing my hair with the hand caused a snapping of tiny sparks.

The most unusual aspect of the disturbance occurred when I threw a rock along the ground in much the way that one skips a stone over a pond or lake. Every time the rock hit the ground or a piece of brush it gave the appearance of "splashing." The light would momentarily disappear from the contact spot but immediately build up again. I noted that the static could be brushed off the car surface, and it also would establish the light again in a matter of seconds. I obtained no shock from touching any object on the ground or the outside of the car.

My estimate of the speed of the disturbance was about three or four feet a second, or faster. The field seemed to be about 50 yards wide and perhaps some 250 yards in length, roughly comparable to the low cloud above.

I watched the display move quickly up the valley toward Electric Peak until it faded from view and darkness closed in. (It might be mentioned that Electric Peak derives its name from the electric storms that frequent its heights and the surrounding region. It is the highest peak in the northern part of the park.) Upon getting into the car and closing the door, I touched the horn ring and was rewarded with a most substantial shock, the effect of which caused numbness in my arm for several hours. Probably the car had become charged negatively, since it was insulated from grounding by the tires. I must have carried a positive charge from my contact with the ground and the disturbance.

When the experience was described to Ross Gunn, Director of Physical Research at the United States Weather Bureau, he commented that phenomena of this sort are reasonably common in mountainous regions during periods of thunderstorm activity. "Usually the described effects," he commented, "are short-lived and precede a lightning discharge. The glow results from ionization induced by a highly electrified cloud overhead. The electric field necessary to produce an observable glow usually exceeds 2000 volts per centimeter. It is entirely adequate to make one's hair stand on end. In the described case, the overhead cloud was doubtless millions of volts above the potential of the ground. It is a very interesting instance of this sort of occurrence because of its great length and apparent stability."

I don't know whether I would have been able to observe events as carefully as I did if I had known that it was "millions of volts," but in any case I shall certainly remember the experience for a long time as one of the most outstanding displays in nature that I have ever observed.

Carpet Beetles

Can you tell the damage they cause from that of the less destructive clothes moth? And do you know how to control their depredations? Here are the answers

By C. H. CURRAN

Curator, Department of Insects and Spiders, American Museum of Natural History

AMNH photo

▲ SPRAYING WITH a one per cent emulsion of DDT, Chlordane, or deodorized Benzinehexachloride offers good protection against carpet beetle larvae. For effective control, plan on two gallons per room, with two or three sprayings a few days apart

AT almost any time during the year, but especially during the warm months, you may notice on your window sill some chunky, brightly ornamented beetles about one eighth of an inch long. If your eyesight is good and you happen to enjoy beauty in color arrangements, you will stop to admire the little creatures. If you have a magnifying glass, you will discover that the color pattern is due to the presence of tiny scales of different colors; and if you examine several beetles, you will find that the color pattern is almost the same on all of them.

Should you touch one of these beetles, it will immediately draw in its horns and legs and play dead. Often it will remain quiescent for two or three minutes and can be admired at leisure. But don't admire it too much, because it is one of the carpet beetles, and its offspring are likely to cause you anguish and perhaps a great deal of expense.

There are a number of kinds of carpet beetles, and most of them specialize in a particular type of destruction. Some prefer carpets, others like the inside of furniture, some are inveterate wanderers and chew up things in unexpected places. The larvae of all of them (and these are the things that do the damage) lurk in dark places

: BLACK CARPET BEETLE has boarded man in almost every part of the , but in the United States its larvae more damage than any other house- pest

◄ LARVA of the Black Carpet Beetle (enlarged and natural size). It feeds on almost anything of animal origin, but woolens are its favorite meal

Photos courtesy Dominion Dept. of Agriculture, Ottawa

and are seldom seen—at least until they have ruined clothing, blankets, socks, furs, or almost anything made from animal matter. Even skins, hides, and many kinds of foodstuffs may be eaten. Because of their furtive tactics, they do not receive nearly so much blame as they should. Indeed, a great part of their damage is charged to clothes moths. Actually, clothes moths are relatively small fry compared with these beetles. Once a clothes moth larva begins to chew on something it stays put, but not so the carpet beetle larva. If it becomes dissatisfied with what it is eating, it will wander somewhere else, picking up choice morsels as it goes. Once established, the carpet beetle is difficult to eradicate.

The adult beetles generally like to get out-of-doors, where they can feed upon the pollen of flowers, which is apparently all they eat. Spirea is a favorite with them. Hundreds may be seen on a single bush, tumbling all over each other in their quest for food. Some of the free-flying females will find the nests of birds or rabbits, the fur of some dead animal, or the pellets of an owl. In the open, their life cycle is slowed down, so that the larvae may require two or three years to reach maturity. Apparently all except the Furniture Beetle are able to survive our coldest winters.

A very large percentage will find their way back into buildings and search out suitable materials upon which to lay their eggs. This is one reason why buildings or parts of buildings close to flowering shrubs are usually more heavily infested than others. If closed windows thwart their yearning for sunlight and food, they will get along fairly well indoors, proceeding with their family life. Fortunately, they are not particularly prolific. The offspring of a female may number from only 50 to 200, which is roughly comparable to the clothes moth but far below the productivity of most other insects.

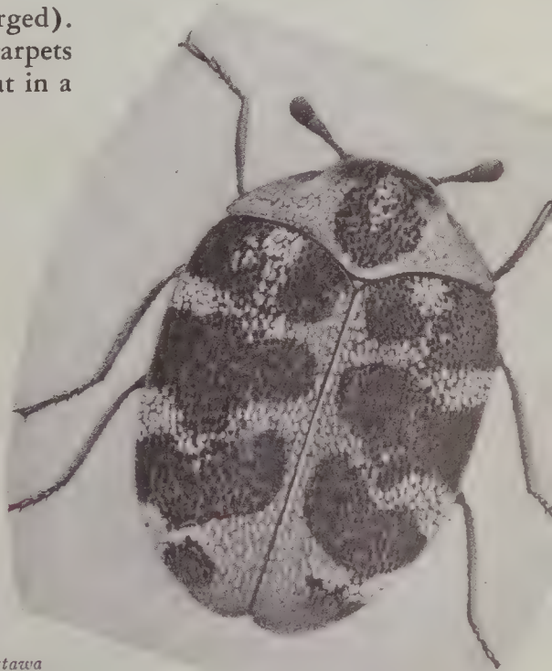
The greatest wanderer among the carpet beetles is *Attagenus piceus*, commonly known as the Black Carpet Beetle. It began its wanderings in eastern Europe and Asia and has taken up its residence with man in almost every part of the world. It was undoubtedly an unknown companion of the earliest settlers in America and probably took its toll of their meager wardrobes, but it did not receive a name until a year after George Washington became president, in 1790.

Like the early American settlers, the Black Carpet Beetle found the country much to its liking, and it prospered. The relatives it left behind in Europe have apparently continued their humdrum and unexciting lives, because they are still of minor importance as household pests. But not so the immigrants. They have kept pace with the growth of the country, and today their offspring can boast that they cause more damage than any other household pest.

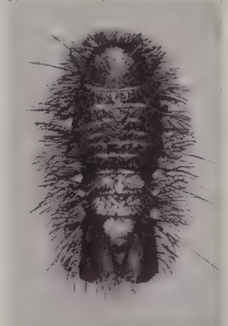
They are rather general feeders. You might find the larvae living in the sparrow's nest outside your window or feeding upon milady's choicest silks. They feed no more enjoyably upon a mink coat than upon one that is a mixture of wool and cotton. Feather pillows intrigue them and so do woolen socks. They will eat dried soups and powdered milk, and anything containing yeast will attract them. They relish dried insects and dried plants. They will only occasionally devour white cotton goods, especially if they contain starch. They'll eat almost anything of animal origin, but woolens are their favorite food.

Extensive and serious damage may result in various ways. In a large and exclusive apartment house on New York's Central Park, the residents of most of the apartments facing the Park complained of damage by the beetles. In some cases it was stated that the larvae crawled over the beds, and one tenant claimed that two or three could be found each day between the sheet and mattress of the bed in which she normally slept. After a few such experiences, she could no longer endure the thought that

➤ THE BUFFALO CARPET BEETLE (enlarged). Its larvae favor furs, woolens, and carpets and have been known to ruin a fur coat in a single season



▼ THE LARVA of the Buffalo Carpet Beetle (enlarged and natural size). Once it has found a good feeding place, it is apt to settle down there and reach out in all directions in search of food



Photos courtesy Dominion Dept. of Agriculture, Ottawa

Photo courtesy Dominion Dept. of Agriculture, Ottawa

THE LARVA of the Varied Carpet Beetle is not too common or too destructive in the home, but its preference for dried insects makes it the chief pest in museums. (Photo much enlarged)

the ugly little worms might crawl over her, and, moreover, she was afraid they might carry some disease. The tenants were certain that the larvae and beetles were entering the apartments from the hallways. In this case, it was not so.

An examination of the infested apartments and hallways quickly clarified the situation. The heaviest infestations occurred between the fourth and ninth floors. In practically every apartment examined, dark closets and dark sections of the rooms showed a light to moderate infestation. In a few closets, larvae were fairly abundant in cracks in the floor and under packages and other stored materials. They had not gone far into the halls. They had entered the apartments through the windows as healthy adult beetles. The Park was their outdoor feeding ground. They had mated there, and the females returned to human habitations in order to find food for their offspring.

An entirely different situation occurred in an apartment in the borough of Queens. This was a much older building, and the hall carpeting had been in place for many years. Large stretches of it along the walls had been honeycombed by the feeding larvae. Since the larvae wander freely, it was only natural that they had found their way into apartments. It was not uncommon to observe a half dozen of them in a single hour slithering away beneath a closed door or heading for concealment under rugs. Many of them had found their way into closets to feed upon winter clothing and blankets.

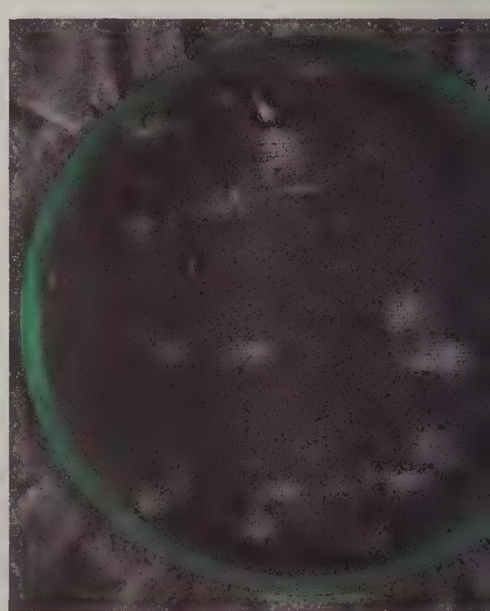
Even a building or apartment that has been vacant for two or three years may house a huge population of this pest, if there is adequate food. Usually the buildings have been left in an infested condition. In the lint in floor and wall cracks and behind baseboards, there may be plenty of food to maintain a thriving host of larvae for many years. Their presence is easily detected in such a case by the scores of dead adults on window sills and upon the floor beneath, where they have died in an attempt to reach the outer world.

One of the most serious infestations that has come to my attention occurred in a factory building used for the manufacture of dried soups. The building had been vacant for a considerable time, and there was no indication that pests were present. But in late spring adult beetles began to appear in alarming numbers. I was unable to determine what had been processed there previously, but it was certainly something that appealed to the larvae. It did not take long to discover that the beetles were emerging from cracks in the floor. These were packed solidly with whatever the larvae were eating, and hundreds of holes had been chewed in the caked substance by the adults to enable them to reach the wide-open spaces. Control was complicated because there was a double wooden floor of rather rough construction.

The Black Carpet Beetle is well adapted to survival under adverse conditions. Under the most favorable conditions, with ideal temperature and an abundance of food, it may develop from egg to adult in about six months; but if the going is rough, the life cycle may require as much as three years. The normal period of development is one year.

It is the ability of the Black Carpet Beetle larva to endure hardships, together with its habit of wandering about and feeding whenever it is hungry, that makes it such a serious pest. Most carpet beetles, like clothes moths, feed within a limited area. But a single Black Carpet Beetle larva may eat in a score of places, chewing halfway through the cloth or chewing off patches of fur over a large area. The damage may pass unnoticed, but once the clothing is worn, the weakened strands quickly give way, leaving the owner to wonder why such a thing should happen.

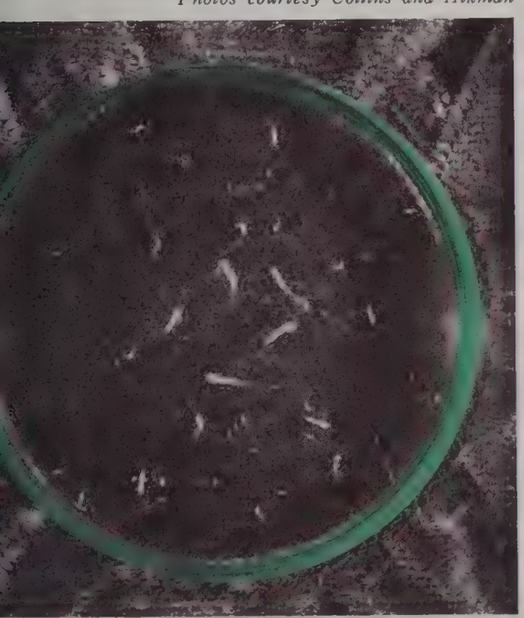
Anthrenus scrophulariae is known in Europe as the Old Fashioned Carpet Beetle or the Common Carpet Beetle. In America it is the Buffalo Carpet Beetle or Buffalo Moth. Many Americans have the idea that it bears this name because it was first a pest in Buffalo, New York. Actually, the insect was described in Europe more than 100 years before it was found, as



THESE DAMAGED SPOTS in a piece o treated mohair are the work of Black C Beetle larvae. In a controlled experimen larvae were placed in the mohair and in months had caused this damage

an immigrant, in Massachusetts. Another, and more logical explanation for the name is that the larva is so chunky and well covered with fur that it might give the impression of a buffalo's head and shoulders. But even this explanation is evidently without foundation. Almost certainly the origin of the name is to be found in the memories of a rapidly dwindling number of Americans who lived in the days when (or shortly after) great herds of buffalo roamed the American plains. In those horse-and-buggy days, and even as late as the 1890's, almost every farmer, and untold numbers of town and city dwellers, owned a buffalo robe. It was looked upon as a necessity for winter driving. Our robe, which lasted, I am sure, until close to 1910, had two purposes. It served as a bedroom rug. In winter, we children would leap across the cold floor and land in its heavy fur, grateful for its warmth as we dressed hurriedly for breakfast--and school. At other times, when we hired a horse and cutter (sleigh), or went on hay rides, the buffalo robe went with us to keep us warm. I do not remember what happened to our robe, but it undoubtedly became old and decrepit. The "Buffalo Moths" probably helped a lot to render it useless, because such a skin provided an ideal breeding place.

Photos courtesy Collins and Aikman



LARVAE WERE PLANTED on this piece of ated mohair velvet, and at the end of a six-ır test, no damage had resulted. Carpet etles are hardier than clothes moths and ore difficult to kill

Furs, woolens, and carpets are the favorite foods of the Buffalo Carpet Beetle, and when buffalo robes were stored for the summer they naturally became infested. Hidden in the deep, thick fur or in creases in the woolen backing of the skin, the larvae remained undisturbed during the warm part of the year, which is their growing season. I do not happen to have seen a badly infested buffalo robe, but I have seen other furs that were ruined by this pest in a single season.

The larvae prefer to work in the deep, dark fur, chewing off and eating the bases of the hairs. Once they have found a good place to feed, they are apt to settle down. At the base of fur hair, they build a little cell and reach out in all directions in search of food. They do not require too much in a single meal, and they may go for days without feeding, but by the time they have reached maturity, a quarter square inch of hair may have been chewed away at the base, and when the fur is worn or brushed, the loose hair is pulled out. In the days when coonskin coats were a mark of collegiate sophistication, I saw examples that were ruined in a single summer. One thing that helps to reduce the extent of damage by these beetles is their love for the skin itself, because the rich oils it contains sometimes cause them to feed upon the leather without eating clear through it, rather than upon the fur.

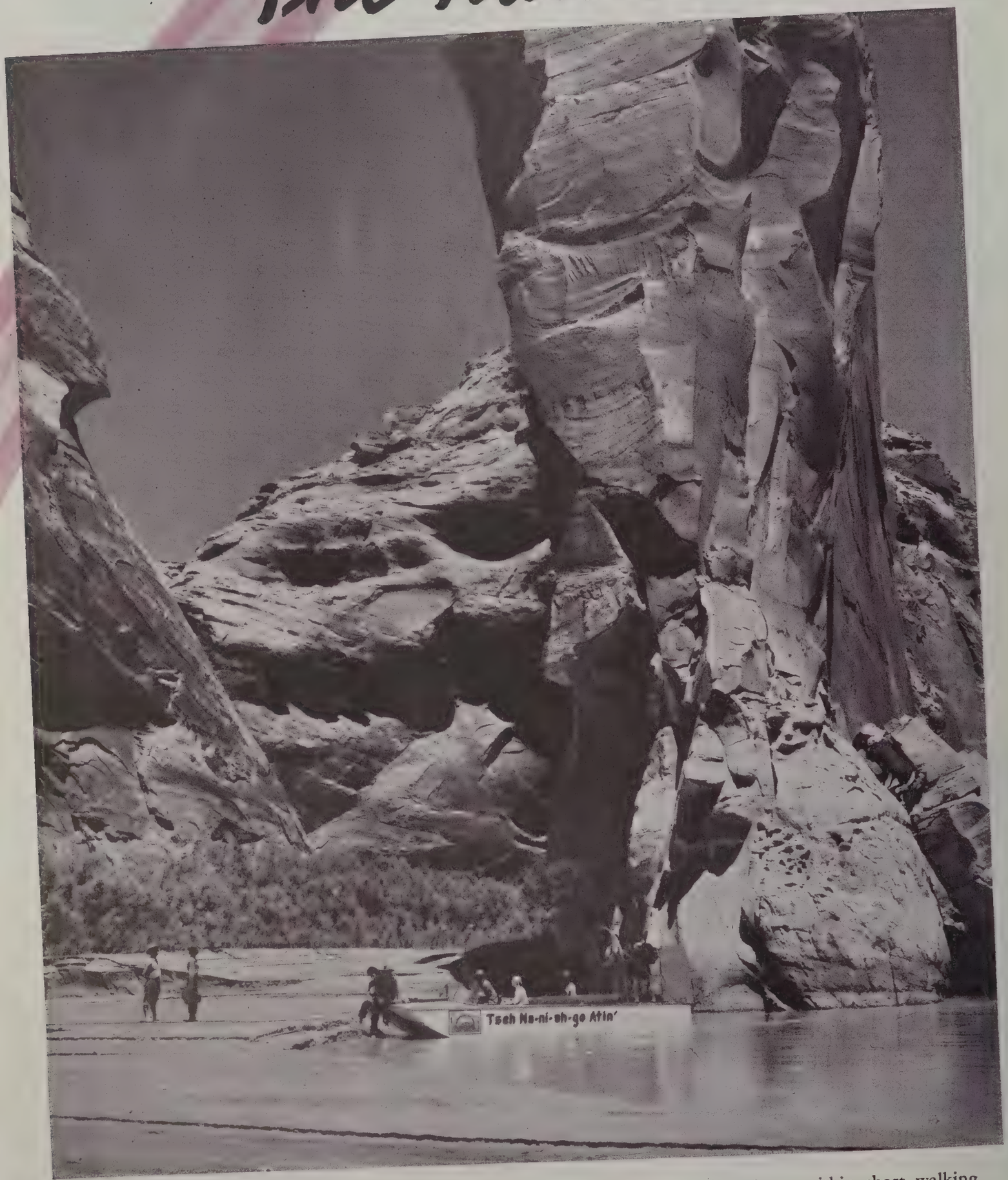
In deep and luscious woolen carpets, the damage done by this beetle may be concealed and not understood by the casual observer. Some years ago, I was called to the home of a former postmaster-general to determine the cause of damage to the living room carpet. It had been the custom to keep the shades drawn during the day, unless there were visitors. As a result, the room was in darkness, or at least very dimly lighted, for most of the 24 hours, and the Buffalo Carpet Beetle found things entirely to its liking. The broadloom carpet that stretched from wall to wall undoubtedly looked quite normal to almost everyone and was surely greatly admired by those whose feet trod upon it. But having seen such things before, it did not look beautiful to me. All around the edge of the carpet, two to five feet from the wall, were tiny mounds. Beneath each mound was the larva of a Buffalo Carpet Beetle that had chewed away the base of the warp. I explained the situation and to demonstrate pulled away the loose wool and disclosed the culprit. The party who had sought my advice (an interior decorator) was so intrigued by the "discovery" that she went about the room on hands and knees, plucking at every little elevation. She stopped only when I pointed out that if she kept it up, little of the carpet would be left.

In some parts of the country, the Buffalo Carpet Beetle is the chief pest; but it apparently does not get along too well with the Black Carpet Beetle. Where the latter occurs, the "Buffalo Moth" usually takes a back seat. In buildings heavily infested by the black variety, the "Buffalo Bug," as the larva is often called, occurs but sparingly. I suspect that the wandering habits and general feeding habits of the Black Carpet Beetle discourage not only the Buffalo Carpet Beetle but also other members of the genus *Anthrenus*. It is quite possible that the larvae of *Attagenus* will eat the eggs and young larvae of its relatives.

The Varied Carpet Beetle (*Anthrenus verbasci*) resembles the Buffalo Carpet Beetle in many respects but is much less brilliantly variegated, since it wholly lacks the reddish scales that form such conspicuous markings on the latter. It is not encountered too commonly in America, and extensive damage by it is rare. While it does like woolens, furs, feathers, and related things, it seems to prefer dried insects to all other articles of food, and it is the chief pest in museums. It shows good taste in its second preference, which is silk. The Mu-

Continued on page 282

The Rainbow Land



▲ SENTINEL ROCK. Passengers in the "airplane boat" pause to view this 300-foot column of rock that guards the entrance of Waweap Creek. The boat will take them ultimately to within short walking distance of the famous Rainbow Bridge, usually approached by an arduous overland route

Glen Canyon

Stories and scenes from a little-known section of our spectacular Southwest—a region now becoming accessible to the tourist who likes to venture from the beaten path

By JOYCE ROCKWOOD MUENCH

Photographs by JOSEF MUENCH

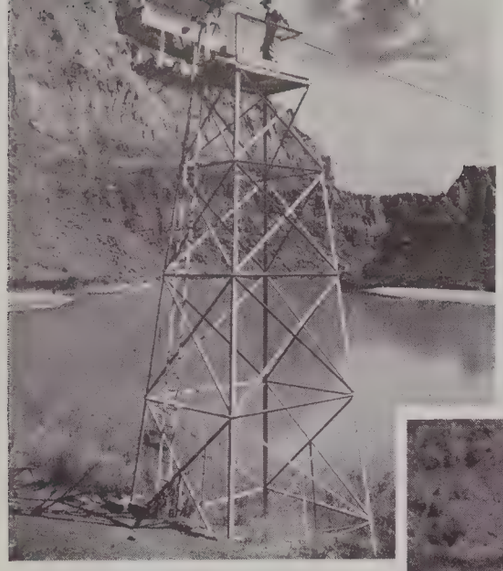
▲ THE WORK of the mighty Colorado in carving these canyons can now be conveniently studied from water level. This strangest of all river boats is driven by an airplane propeller. Passengers study the colorful cliffs at close range and camp for the night where sunset finds them

GLEN CANYON might be called the little-known parent of a famous child—the Grand Canyon. You may not have heard of it, since it has no Hoover Dam, no Grand Canyon National Park, and not a single bridge to publicize it. Glen Canyon may be almost peaceful in comparison with several of the more rambunctious offspring of this fabulous river system, but the name Glen scarcely does justice to some of the finest stone architecture in the world.

The Rainbow Land through which the Colorado River has cut its way in southern Utah and northern Arizona embraces 162 magnificent miles of winding art galleries. Burnished red sandstone cliffs hung with "tapestry," the flying buttresses of Rainbow Bridge, and the overpowering simplicity of Music Temple are within this domain. Here one also sees the staunch pillars of other stone bridges—Owachoma, Sipapu, and Augusta—the majesty of Navajo Mountain, and, of course, the sinuous, powerful Colorado, coursing silently through primeval land in the largest unsurveyed area in the United States!

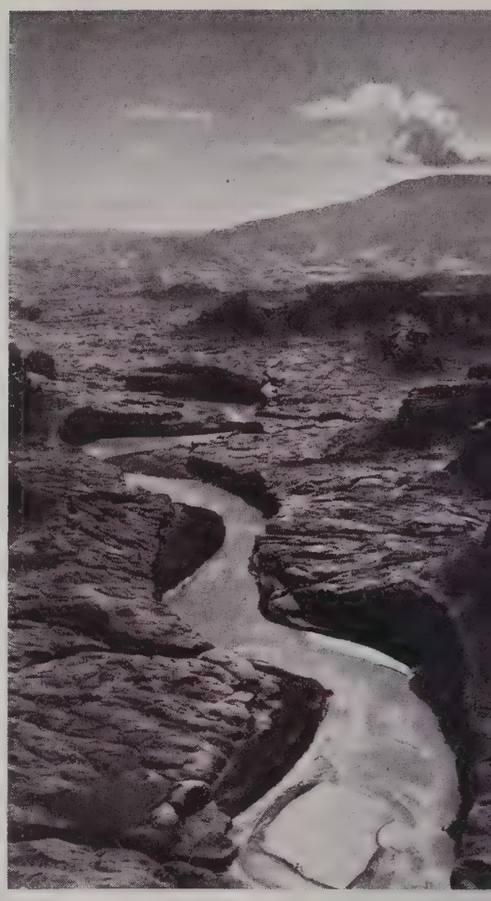
Native legend has it that long ago the Indian god Tav-woats made a pathway from the balmy western land, so that an old chieftain might visit his dead wife, Nu-ma. The Indian promised never to describe the country and to cease mourning for Nu-ma on his return. To make

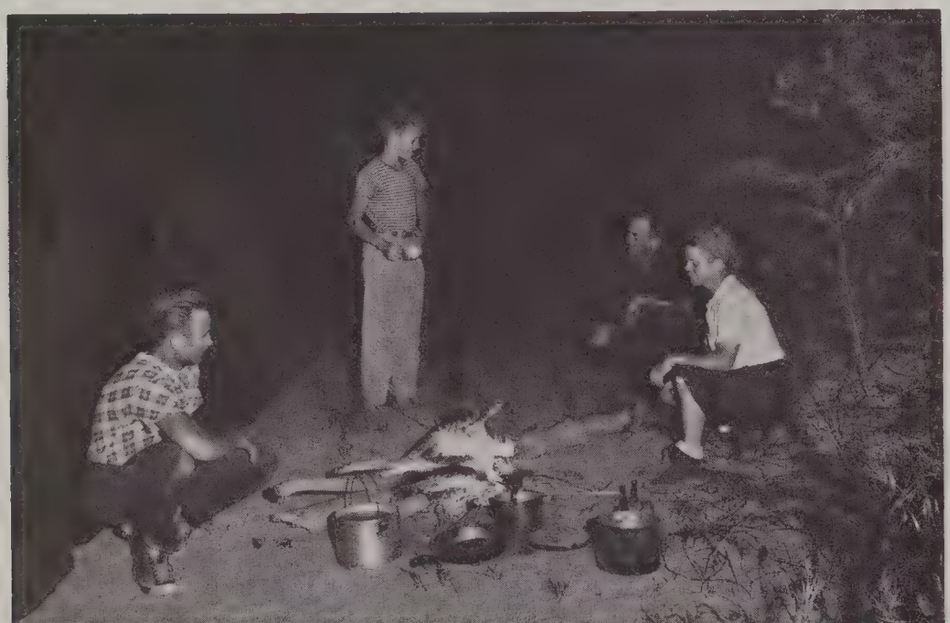
➤ EVENING IN GLEN CANYON. The boat passengers have climbed up from the river's edge to watch the setting sun paint the walls of Glen Canyon with richer hues. Most of the area they view here has not been surveyed



➤ WATER-GAUGING CABLE TOWER at Lee's Ferry. By means of the cable car and the instrument suspended near the base of the tower in this photograph, the velocity of the Colorado River can be determined at any distance from shore. The resident engineer, Mr. Jim Klohr, is seen on the platform

➤ MR. KLOHR exhibits the delicate instrument whose revolving cups measure the velocity of the river. The 100-pound weight attached to the instrument enables velocities to be taken at various depths





➤ CAMPING ON THE COLORADO. A fire built on a sand bar along the shores of the Colorado River in Glen Canyon makes home for the night for a party going upstream from Lee's Ferry in northern Arizona. When the fire goes out, the voice of the river will lull the travelers to sleep in their sleeping bags

➤ FISHING FOR SUPPER. In a quie sweet-tasting catfish are easily caught evening meal. The boat has an India meaning "Trail to Rainbow Bridge"

➤ MRS. ROLAND USHER of Cortez, Colorado, shows the rod with which she caught these fish

sure that others wouldn't make the journey, Tav-woats filled the rocky trail with a thundering stream. And that, say old Indians, is how the Colorado River and its nineteen yawning gorges came into being.

White men have shared the Indian's fear of the river, spinning their own weird tales. In earlier days, people used to say that the stream dived underground and plunged over tremendous walls as it raced through a region destined to remain forever unknown!

Lest you think too lightly of Tav-woats' injunction, consider that no man has yet been able to follow the Colorado upstream through its 1360 miles of twisting rapids, and not many have descended it.

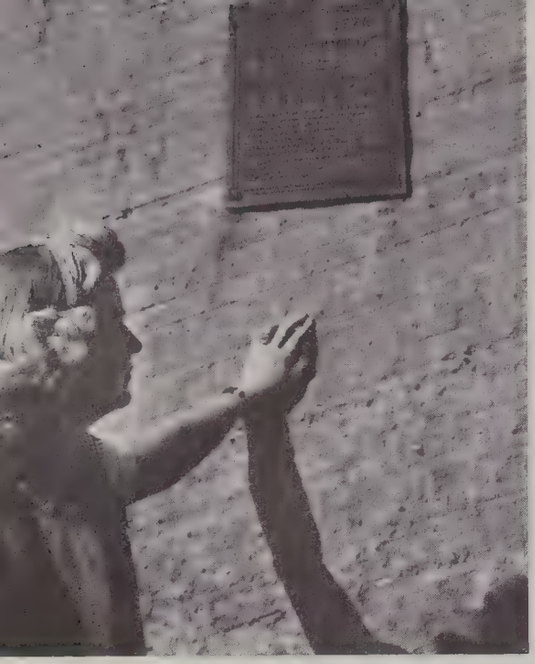
But it is high time that Glen Canyon made its debut and that it be accepted into the ranks of natural marvels. Don't expect it to offer you material wealth or hospitable lands for settlement, but be prepared to stand spellbound before its sheer grandeur.

Glen Canyon is less temperamental than most of its kin and maintains a gradual two-foot drop to the mile. The Paria River, which enters it from the Northwest, drops 7400 feet from source to mouth—an average of 43 feet to the mile. The Escalante drops 41 feet to the mile; the Last Chance, 70. Still more precipitous is Warm Creek with 90, Waweap with 100, and Rock Creek which tops them all at 285 feet downward for every mile ahead!

Rainfall is a scant nine inches in the highlands of the plateau and five inches in the lowlands, but it is delivered like a sword thrust, now here, now there, never generally. Extremes in climate, terrain, and formations are the norm. With such spasmodic rainfall, it is no wonder that the swift tributaries pour vast quantities of silt into the main river, which already has no small burden collected farther upstream. Some of this falls to the bottom to be stored until rising water can increase the

◄ AN AIRPLANE VIEW shows the rugged land through which the Colorado has cut its serpentine course. Navajo Mountain, 10,416 feet high, rises in the background

▼ FOR 135 MILES in southern Utah and northern Arizona the Colorado River passes between the red sandstone walls of Glen Canyon. The absence of rapids enables the traveler to enjoy the spectacular rock sculpture without anxiety

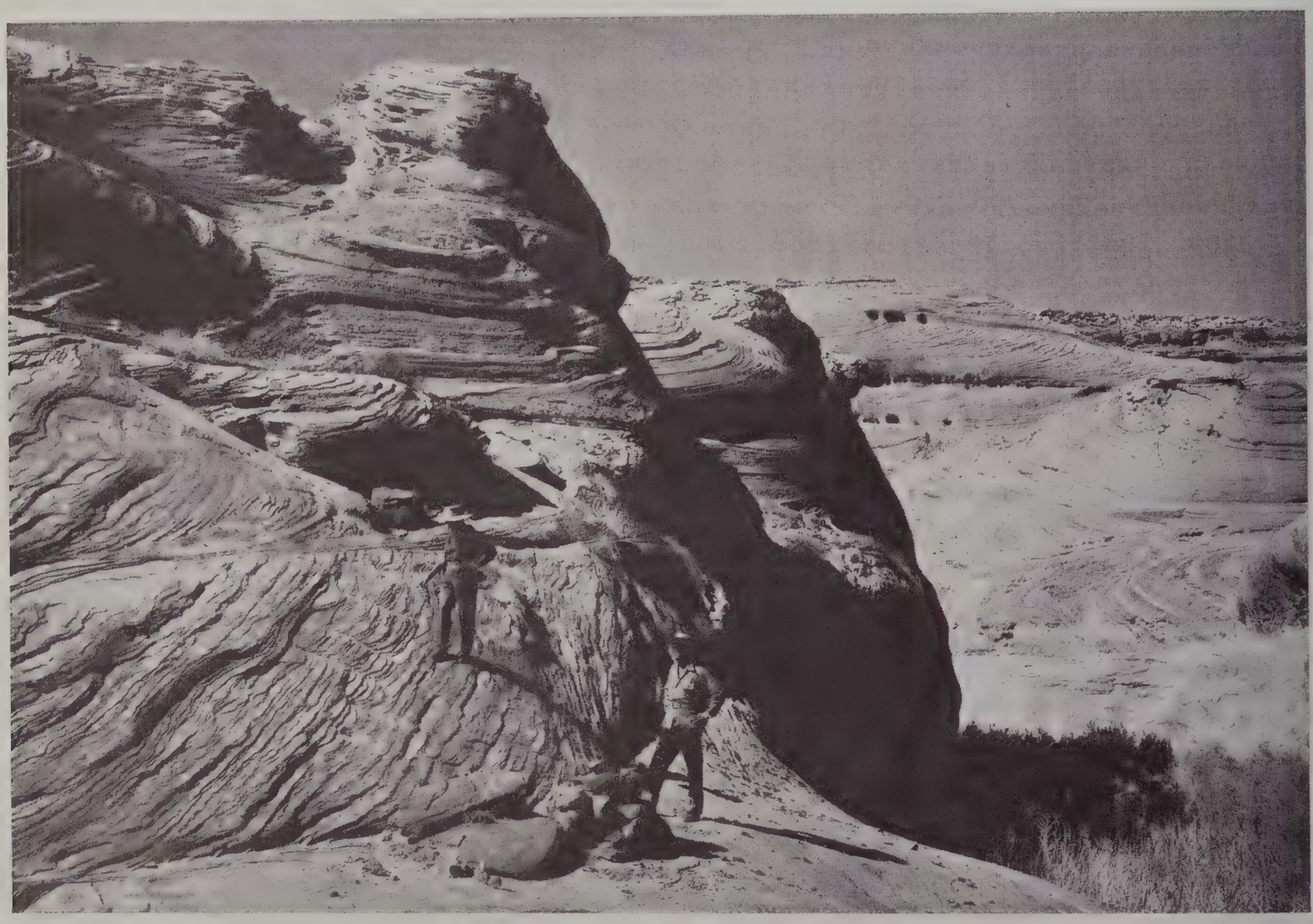


carrying capacity of the river. But it will take another uplift of the land to sharpen the Colorado's cutting tools.

It is now possible to view the majestic rock-sculpturing of Glen Canyon from an excursion boat powered by an airplane motor. In this unusual boat, Art Greene will take you around a thousand snaky turns to reach the goal of all dreamers, Rainbow Bridge.

From the water level, the fine graining of Glen Canyon's sandstone and the elaborate cross-bedding can best be seen. But it is from a distance that the massiveness and raw color of the curving walls can best be appreciated. Here and there, it is as though a

◄ WHERE WHITE MEN first crossed the Colorado: a bronze plaque commemorating an important achievement in western exploration. Here, in 1776, a Spanish party struggled down a narrow gap to ford the river, which otherwise would have interrupted their 1600-mile journey through the wilderness



▲ HERE THE SPANISH EXPLORERS, including Father Escalante and Father Dominez, brought their horses down over the swirling sandstone to reach and cross the Colorado River in Glen Canyon. At the right, the rock drops off to a little creek leading down to the Colorado

► FARTHER UPSTREAM, pioneering history was again made at Hole-in-the-Rock. These "Mormon Steps" were cut in 1880 to enable 250 Mormon pioneers to descend a 1000-foot break in the cliff, along with 80 wagons, 200 horses, and 1000 head of cattle

painter had splashed huge bands of colors to produce what are known as "tapestry walls" along these corridors of time. Nature protects them by layers of so-called "desert varnish." But every season of frost and snow prepares a layer of outworn scenics for the next downpour to wipe away, and in places great blocks of material have been neatly squared off, ready for removal to the lower reaches.

Here and there throughout the length of the Canyon, wind, water, and sand have shaped indentations from egg-cup size to gargantuan arches and embayments. Music Temple is the finest specimen of this artistry. About 500 feet in diameter and 200 feet high, its perfect acoustics carry a whisper across a clear pool and among the moss and ferns of this secret chamber, which is reached from the near-by river through a narrow gorge. Monuments stand guard like ticket takers wherever a stream comes into Glen Canyon and lead to other galleries and showrooms. Sentinel Rock at Waweap Creek is a great carved tower about 300 feet high, and Incinerary Urn at Warm Creek is a portentous and classical symbol on the Utah-Arizona border.

Some of the early explorers left their mark on this forbidding region. In 1776, a Spanish party struggled down the narrow gap to ford the river—one adventure in a 1600-mile jaunt through the wilderness. This spot, known as the Crossing of the Fathers, had been used by the Ute Indians for hundreds of years, and the Navajos continued thereafter to take advantage of it. A bronze plaque set into the sandstone commemorates the first crossing of the Colorado by white men, and faint scratches on slippery rock may have been made in that year to get Spanish forces safely down to the river's edge.

Pioneering history was also made farther upstream at Hole-in-the-Rock. In 1880, 200 men and women and 50 children descended a 1000-foot break in Glen's walls over a "road" constructed for the passage of 80 wagons, 200 horses, and 1000 cattle from Escalante to found the settlement of Bluff on the San Juan River. The feat was one that anyone, laboriously climbing up through that desolate "hole," will agree may never again be duplicated. A trace of the trail on loose slopes, some beautifully weathered steps, and a recent plaque of bronze are all that remain of what some consider the most formidable wagon trek in world history.

Lee's Ferry, too, is steeped in

▼ **Rising sheer from the water's edge, the sandstone walls of Glen Canyon soar skyward. The extreme edge of the Kaiparowitz Plateau is seen across the water, above walls embroidered with fantastic designs and arches in the making. Here, in Glen Canyon, is some of the world's finest stone architecture**

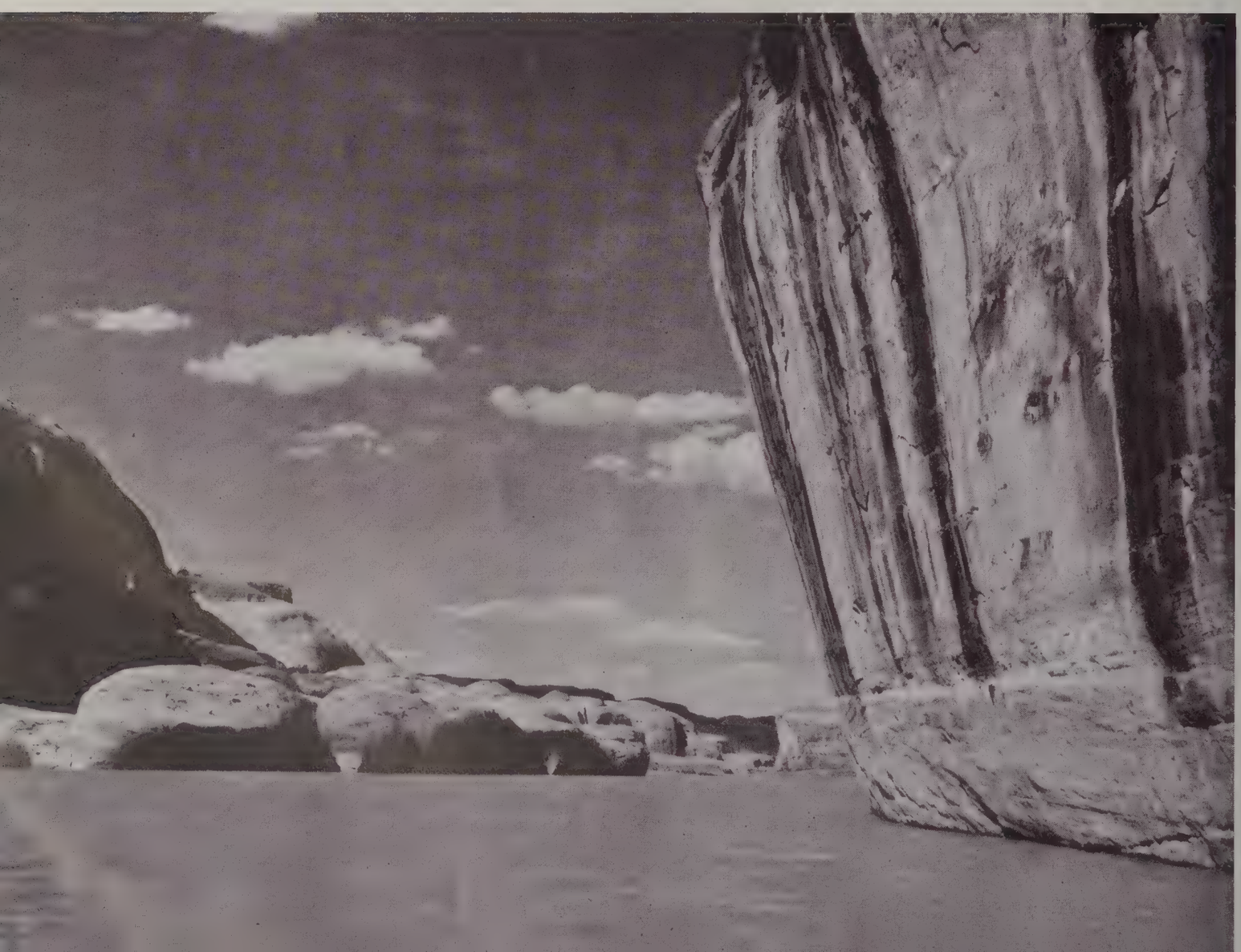
early western tradition. A gauging station on the bank of the river now brings new activity to the tiny fort and ferrymen's cabin that slumber in the sun. Near by, in the widening valley of the capricious Paria River, John D. Lee's early farm still produces watermelons and asparagus. A row of tiny graves in a neglected cemetery tells of tragedy that struck at the ferryman's family one summer, miles from any doctors who might have diagnosed and treated diphtheria. From 1872 until 1929, when it was outmoded by Navajo Bridge and U. S. Highway 89 (only 7 desert road miles away), the ferry made trips across the water. Every river adventure has included this spot, and it is the division line for the Upper and Lower Colorado, the zero point for measuring up and down the stream. Travel up through Glen Canyon begins here.

At Mile Sixty-eight the dark slit of Aztec Canyon beckons the visitor toward the Rainbow Bridge. A trail ascends gradually between sheer walls to what is probably the most famous natural arch in the world. Since Dr. Byron Cumming's party found it in 1909 with the aid of a Piute guide, only about 5000 white men have seen the Rainbow. Now a National Monument, it is reached by trail from Rainbow Lodge in Arizona or down the San Juan's exciting course through Utah. With a third route now possible, up the Colorado itself, thousands more will come, finding its noble proportions a fitting climax to the architectural splendor of Glen Canyon.

Still farther up, Dandy Crossing (now known as Hite) boasts the only ferry in our wonderland. It was first used as a ford in 1880, and miners pursued their forlorn hopes from it and from Lee's Ferry. Oldtimers can rattle off the names of gravel bars where homemade rockers and sluice boxes were used in the search for gold—Grub Stake, Good Hope, Olympia, California, Moki, New Year, Burro, Boston, Klondike, and Shock. Good Hope, the only patented land, was strong enough to induce promoters to bring in a water wheel. A power dredge was operated at another in 1900 but did not produce enough to pay for its installation. The California, however, brought $10,000, and it is still possible to earn daily wages from recurrent streaks on the river.

There was a renewal of mining activity in 1910 with steam dredges and power shovels freighted from Marysvale. A steamboat was set afloat to pull barges upriver to Warm Creek. Coal mined there and carried on horseback to be floated down the water was used to provide power for a gold mine on the Paria River. The first trip proved

▼ ONE OF MANY REGIONS reached only by boat. The overhanging cliffs at right bear the strains of water, while the rocks at left have been shaped like loaves of homemade bread

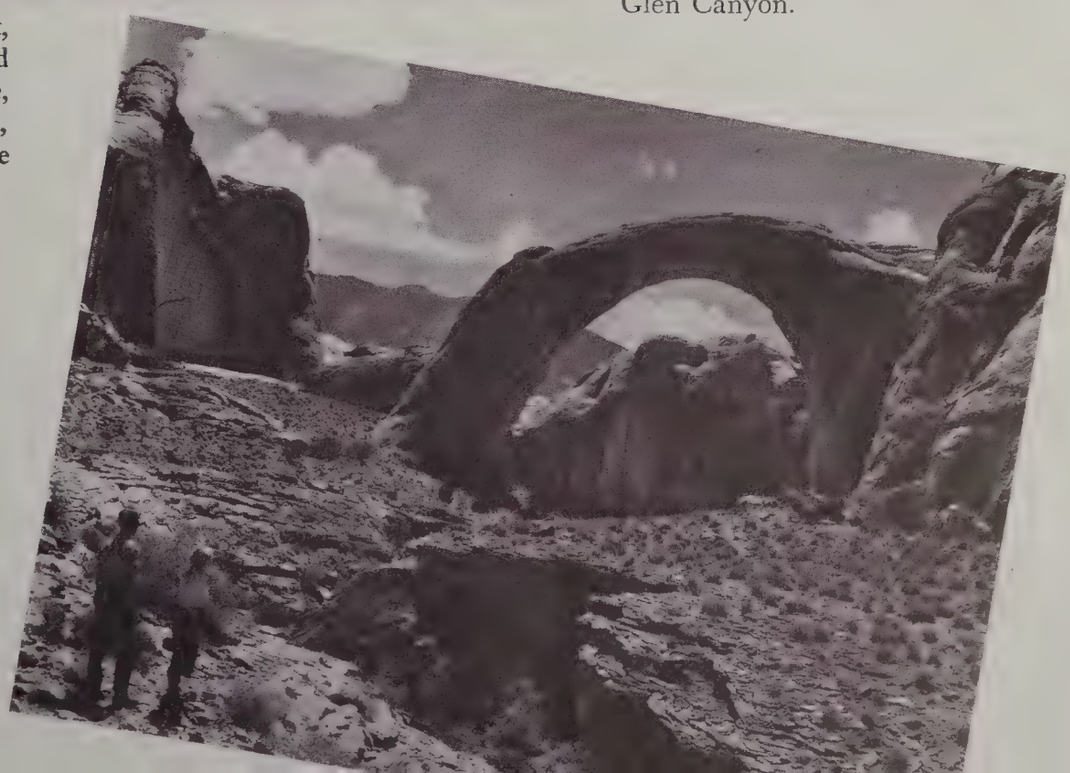


▲ BRIDGE CANYON. This cleft, with its clear stream, is named for the great Rainbow Bridge, three miles farther up. In places, the sky is almost shut out by the multicolored cliffs

that the big boiler ate up all the coal that could be dug and could scarcely hold its own against the current. At Low Water, the rusting old boiler and hull peer disconsolately above the muddy waters.

Glen Canyon and the Colorado River have not treated kindly those who would search for wealth in the ground. But they have no objection to men clambering over the rocks, delving into a hundred canyons that cry out for exploration. Hidden here are arrowheads and pottery that have long lain buried; and the limestone, interlaced between layers of sandstone, provides lush gardens of ferns and saucy-faced monkey flowers. Sand bars, changing from season to season, allow willows and cottonwoods to make shade for noon siestas, and the river is always considerate in providing driftwood for cheery campfires. It offers the delicious meat of the catfish for a nominal amount of effort. Shadowy ravines write an invitation to explorers in their unknown glens and retreating plateaus. Navajo Mountain holds its own mystery for Indian and white man. No Navajo will accompany you to its top, past War God Springs, but scientists say it is a huge laccolith—a great bulge of volcanic rock that never erupted.

The river, self-appointed curator of this canyon museum, alone knows the complete listing of the exhibits in the Rainbow Land of Glen Canyon.



➤ SWEEPING IN A MAGNIFICENT ARC to a height of 309 feet above the bed of the creek, Rainbow Bridge enjoys worldwide renown as a natural wonder, even though only a few thousand people have ever seen it. Its span is 278 feet, and the rock is 42 feet thick at the top of the arch

The First Ascent of El Sangay

▲ THE ONLY INDIAN who had the courage to venture as far as the snow line on El Sangay: Manuel Olalla, a thoroughbred Quechua. He was a trained zoological collector and spoke Spanish fluently. Near by are the grass lean-tos, or *chozas*

Reminiscences of a momentous expedition of 1929, when the Flaming Terror of the Andes was conquered. The adventures of four men who forced one of the world's great volcanoes to reveal its secrets

(Concluding Installment)

By ROBERT THOMAS MOORE
Associate in Vertebrate Zoology, California Institute of Technology

All photographs by Moore Expedition

AS I lay in my blankets listening for sounds that would indicate that our Indian porters were abandoning us, I mused on the bulky animal that had brought a touch of Africa to the Andes. It was not the common tapir of the tropics but the rare Mountain Tapir—a shaggy, black-haired, mahogany-cheeked beast, supposed to be extinct or nearly so. But strange as it may seem, it was a tiny hummingbird that captured my imagination. Once more the Fire-throat, Herran's Thornbill, had called upon us! Like a visitant from some other world, it had volplaned out of the ether and dropped on the golden clusters of our "pear tree," the only touch of color on our wind-blown eyrie. For one dazzling moment it hovered before us—took one sip of chilled nectar—and was gone!

Morning brought drenching rain. The Labyrinth was choked with clouds. But to our surprise the peons were still with us. Their leader had recovered and, miracle of miracles, was willing to proceed! We hastened to take advantage of the changed attitude, but they insisted on taking the hardest route—the Labyrinth! This had only one compensation: we could survey the bird life of the canyons and possibly find the nests of both Fire-throats, *herrani* and *stanleyi*. While we consulted, however, disaster threatened in another form. The best of our two remaining Quechuas was found in the choza, incapacitated by swollen feet. We left him to recover and follow later.

Soon we were slipping and plunging down the worst slope I have ever tried to negotiate. The rains had turned the ash into a jelly-like paste. There was no trail. With heavy loads, neither peons nor ourselves could proceed until steps were laboriously gouged into a zigzag trail. Hours followed which left a dreary memory—a kaleidoscopic vision of icy streams, raging torrents, moss-covered blocks of lava that proffered treacherous footholds, steep slopes and cliffs that were always facing us on the opposite side of streams. Dripping clumps of paja grass lacerated our hands with their saw-edges, and on the endless paramos above this sponge-like world, gnarled trees blocked our progress along knife-edges. Attempts to crawl through interstices were made with sure knowledge that one slip would mean a plunge into the gorge. And always and always there was stream after stream, torrent after torrent, and fords so numerous that definite memory of them is lost. Until—at length we reached the Rio del Volcán!

Here the peons balked. They were tired out. One poor fellow, more heavily laden than the rest, had tottered along until he had to be helped at every crossing. His leader cried out, *"No se puede ir adelante!"* He claimed we were trying to drown them and that they would "die of the cold!"

Persuasion and threats failing, we gave them the one food they wanted—our remaining bread! An added demonstration by Terry, who dashed through the swollen river and then 1000 feet up the opposite cliff, shamed them into moving on. An hour later the fords became more shallow and the water dropped to the knees. We waded for hours in a dark canyon, climbed the sheer cliff of a waterfall, followed an ash plateau beside a cinder canyon, and reached an apparent cul-de-sac, blocked by transverse ridges and deep gorges. That camp for the night we called "Sangay."

By evening the Shroud lifted once more for a moment. There, directly above our heads, gleamed the snow-white cone of El Sangay, tremulous in the failing light. It was actually near! And one of the transverse ridges turned obligingly to the southeast, heading straight for the summit. We were on the northwest

slope of the volcano. Obviously the end of the Labyrinth had been reached.

We now faced the base of a cinder bluff. A hundred yards to the left was the upper end of a huge canyon of great depth, probably 3000 feet. To the right, a small arroyo carried a minor stream. Over our heads hung enormous hummocks of sullen black ash. It seemed that only a slight additional shaking from the daily rumblings of the volcano would precipitate a landslide. A mile higher, the snow began, but we did not find any evidence of the glaciers mentioned by Dyott until we reached the crevassed area on the southern slope of the cone itself.

Again the peons refused to make an adequate choza, and we knew desertion was impending. Mutterings were overhead about "El Nieve!" and "El Volcán!"—up which they feared we intended to force them. Food supplies were dangerously short. Unless the rest of the deer meat could be brought from Carniceria, we would have to reduce our diet to tea. It was decided that Waddell and I would hunt for deer on the morrow while Terry and Lewis would take the ice tent (the "fiala") and pitch it on the snow. We forestalled desertion by sending the well peons back to Carniceria, securing their promise to help Teodomiro bring back the rest of the deer and tapir. They started at sunrise, leaving behind the exhausted peon, who had nearly lost his life the previous afternoon falling from a shelf of the gorge.

The deer hunt failed, but at nightfall Terry and Lewis returned. Success had crowned their effort. The tent had been placed on the last tongue of warm ash that crept far up into the snow field at an elevation of 16,000 feet. At last we had something tangible to fight, something besides water, morass, and clouds. On the morrow we might climb out of the Labyrinth and reach clear sunlight—and ice.

On August 2, Terry, Lewis, and I, with Manuel, the last of the faithful Quechuas, took to the ridge that served as a rib of the black network supporting the white dome above us. As usual it rained, and the cone was hidden by cloud. A black knife-edge wound its way upward, disappearing in the Shroud. Rapidly it narrowed and became bare of any vestige of shrub or grass. From five feet it compressed to four, then to three, then two and one! At length, a bare six inches supported us from the chasms that yawned on either side. We seemed like tightrope walkers suspended on a slack wire in a gloomy atmosphere over depths that disappeared into unknown space. Rain slashed on our ponchos and made the ash like slimy clay. Manuel, with his heavy pack, slipped down on all fours and crept. We took turns cutting steps for our feet. At times the ash crumbled and slithered away. Landslides had serrated the edge in places and compelled dainty stepping, as if we were walking over the bodies of sleeping

▼ ONLY RARELY did the forbidding peak disrobe for the climbers who sought to conquer it. From this point they crossed a number of gorges and ridges which took them out of the picture to the left. They ultimately ascended the knife-edge at extreme left, up to the snow line

enemies. For four hours we crawled like snakes up the skeleton buttresses of the volcano and reached a snow field at 3:30 in the afternoon. And then—we entered the region of Sun!

For two and a half weeks we had lived under the Shroud, veritable frogs with water below us and above. Now we had reached its upper edge and were faced by an intolerable fire that burned into our eye sockets. The glare of sun on snow was terrific. None too soon we donned metal eye-slits and surveyed the amazing new world we had entered. Below us stretched a sea of clouds clear to the horizon—north, west, and south. Its glittering snow-white billows formed the roof of the Shroud and concealed the dismal abysses below. To the east the tongue of ash on which our tent was standing ceased, and a gleaming snow field carried the eye up to the top of a perfect snow cone, outlined in startling relief against a sky of deep ultramarine. The slope seemed invitingly easy, but the morrow proved it an illusion. The appearance of a gentle slope was caused by a flat foreground, lacking shadows, that merged unseen into a steep ascent.

As we gazed, cloud wisps shot up out of the Amazon basin and, enlarging to great cumulus masses, catapulted upward at terrific speed, blotting out the summit. At the same time, the air column lifted the curtains of the Shroud behind us and for a moment revealed the entire route over which we had come during the past two weeks. The knife-edges, the Labyrinth, the Rio Volcán, Carniceria, and finally the whole valley of Culebrillas, its snakelike river, and even the white tent where we had said farewell to Carlos eleven days before, were visible through powerful glasses.

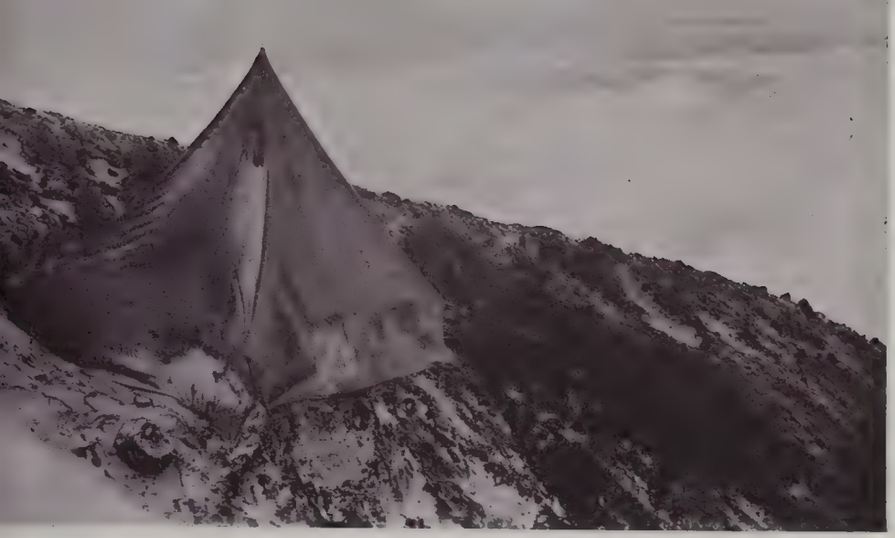
As we watched in astonishment, the dropping temperature warned us to prepare for a cold night. I sent Lewis and Manuel back to Camp Sangay with instructions to bring up the needed equipment. They took the ice ax to negotiate the "Knife-edge." We lit the optimus heater, thawed our frozen imaginations, and cooked a wonderful dinner of our last rice and raisins, using water from melted snow. Crawling into sleeping bags, we expected a cold night, but the ash beneath was warm and would have induced sleep had it not been for other causes. Confident the frozen-in ropes would hold, we were just falling into a doze when a terrific blast shook the tent. With it came the sharp impact of ice pellets against the frozen canvas. Neither of us spoke, but both were keenly aware of impending danger. Plainly the vertical air currents that had skyrocketed from the Amazon were tearing the Shroud to shreds and turning it into a hurricane of snow and hail. The Demon of wind pounded our tent with titanic force. The four-foot tent pole bent into an alarming bow. When the bow released, the tent canvas snapped taut with a report like gunfire. The ropes whipped the ice. Powerful gusts of the storm rolled under the ice cloth and lifted us bodily into the air, dropping us with a thud.

With only two in the tent, visions came of being rolled—tent, contents, and all—over the ridge to the west and down the half mile of ice. We bulked our weight strategically on the windward side behind the cut Terris had made in the ice wall. For four hours the wind buffeted and thumped us, and then came a marvelous calm. This lasted only a half hour, when once more the pounding renewed its onslaughts. Two more hours saw it slacken and allowed a few minutes' sleep before sunrise, when we rose for the contest with the frozen volcano. As I crawled through the low hole, a bleak scene greeted tired eyes. The ash tongue was drifted, and the tent walls were stiff with the impacted debris of the blizzard.

The morning light revealed that the heart of the volcano was not frozen by any means! At a distance, the conclusion had been drawn that no "smoke" was being discharged from the crater and that the so-called "most frightful volcano in the world" was extinct. Now, at close range, it was clear that gas clouds were being emitted, but the gases were unusually colorless. In comparison with the dense masses of gray emitted by Vesuvius, El Sangay's fumes are transparent. And yet they were pouring forth in great quantities. The giant was merely asleep and breathing heavily. The cone was perfect, greatly in contrast with the truncated top drawn by Whymper 50 years before, indicating that it had been quietly building for some time and that the orifice was choked with ash. These conditions are deemed an augury of early activity. It did not give us concern, since an eruption is generally preceded by seismic disturbances of a violent nature, and up to this time we had experienced only one violent earthquake, although there had been many minor "shakings."

These were the things we discussed in the predawn light, while Terry busied himself with breakfast and I endeavored to photograph the still swirling clouds. Although the wind had moderated, it bent the stiff tripod legs like willow wands and pierced bare hands to the bone. A sudden gust tore away the parka I was using as a focusing cloth and hurled it down the western ice slope. The night's snow was picked up by the gusts and stung face and hands like a whiplash. Absorbed in the difficulties of my work, I did not at first notice an increase in the whistling sounds about me, until I was startled by the passing of a large object near my head. Glancing downward I could see it bounding on the ice. It was a ROCK! Twice as large as my fist! Above me others were ricocheting on the uneven slopes. Clearly they were coming from the summit. Was it an eruption? I instantly dismissed the thought when I noticed they were not incandescent. Later we saw many of them lying quietly on the icy slopes near the crater. The powerful winds had disturbed them and set them in motion. If they had been projected from the crater for some time and frozen in the surface, it proved how powerful the wind had been to wrench them from their resting places.

Dropping the tent to save it from wind and rocks and using the tent pole as an ice ax, we started for the summit. Our Paulin barometer indicated we were now at an altitude

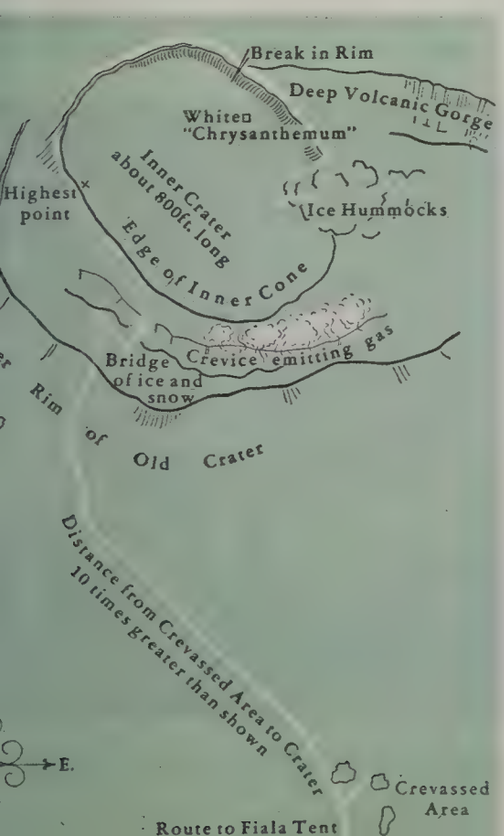


◂ AT THE LOWER EDGE of the snow-cap of El Sangay. As the men lay on the canvas floor of the tent, a tempest raised them bodily and threatened to hurl them, tent and all, into the abyss

▾ A GORGE UNEXPLORED until the Moore Expedition penetrated it: the ravine of the Rio del Volcán. It made a welcome route to the very base of El Sangay. And in it was discovered a bird new to science—the beautiful Golden Tanager, *Tephrophilus wetmorei*

of approximately 16,000 feet. Assuming the triangulation of the mountain to be correct, we had about 1800 feet of altitude to negotiate. Later we discovered that an inner cone had built up almost to 18,000 feet in elevation.

A few steps convinced us we were on the steepest side of the cone—the western. A direct ascent would be impossible without the ice ax, which Lewis had taken the night before for his return over the knife-edges. The frozen slopes rendered our snowshoes valueless. We had brought them and reduced the ice axes to one because Whymper's historic ascents of Andean mountains had indicated that most of them were covered with deep snow. This proved to be true of Mt. Chimborazo later, but above the 16,500-foot level, El Sangay was glare ice. If we were to make the ascent this day without ice axes, we would have to head for the southern slope, whose silhouette against the sky indicated an easier gradient.



It was on this southern slope that Dyott had plunged into deep snow and crevasses, but its easy grade was too inviting to be resisted. Furthermore, we would avoid the dangerous fumarole directly above us. We headed obliquely upward shortly after dawn. Soon the surface became so slippery that steps had to be gouged with the metal end of the tent pole. The force of the blows broke the pole. The slope became steeper. Terry slipped twice and barely prevented a long glissade. Another sharp blow with the pole sent the unbroken half flying down the ice field; it dropped out of sight a quarter of a mile below. In a vain effort to catch it, Terry took a long slide but succeeded in stopping himself on a flat area that saved him from disaster. We returned to the fiala tent, defeated. A cold lunch followed. It was impossible to cook outside the tent because of the wind, and the tent could not be raised without the pole. A sparkling afternoon tempted us to try again.

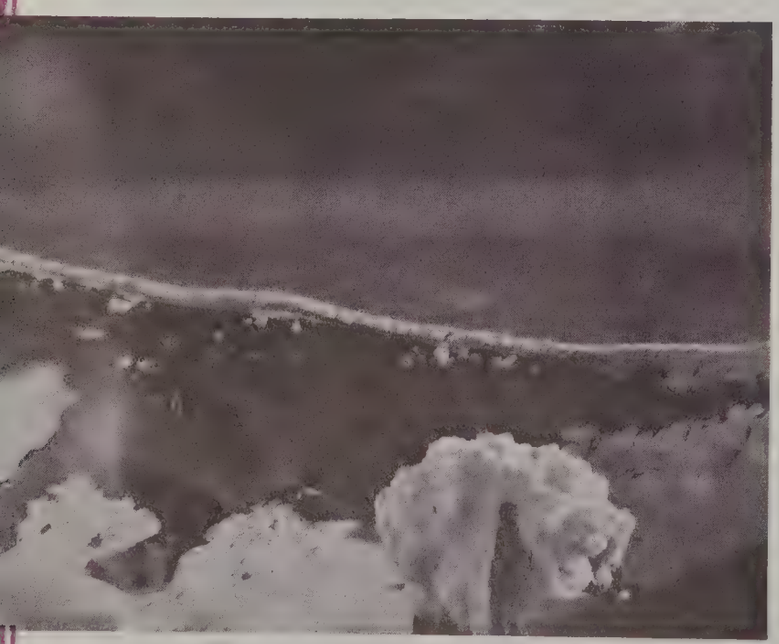
Considerable time had been spent in a successful attempt by Terry to recover pole and parka in the cinder field below. His energy was astounding! Every step was costly, a severe strain on heart and lungs in this rare atmosphere three miles above the sea.

Once more we pointed upward. The old steps made progress faster. The surface had melted slightly under the direct rays of the tropical sun. By 3:30 we had passed our old mark and reached an area of curious hummocks and mammoth formations. Some of these forms were 50 feet in height and conjured thoughts of titans of the last Ice Age. Obviously they indicated the beginning of a crevassed area—probably the sector that had defeated Commander Dyott in his courageous effort, after all his companions had been stopped by fear or mountain sickness. As Terry changed films to photograph the area, a sudden gust tore the film adapter out of his hands and sent it sliding down the mountain. It might have stopped on the softened surface had not some queer trick of fate turned it on edge and whirled it at a fast rate. The summit did not seem more than 1000 feet above us, but without camera as witness, an ascent seemed of doubtful value. Reluctantly we postponed further effort until the morrow.

Waddell and Lewis, without Manuel, reached the tent at 5:30 P.M. They brought good news. Teodomiro and the peons had reached Camp Sangay with deer meat. We could devote one more day to the ascent with fair regard for the safety of the party. Unless we should be impeded by swollen rivers, it would be possible to get back to Culebrillas by husbanding our rations. We spliced the broken tent pole with the ice ax that Lewis had brought and once more enjoyed a cooked dinner of hot venison and fried potatoes. The crowding of four persons, four sleeping bags, cameras, and other equipment into a six-by-six tent caused much amusement and took one and a half hours.

At 5:30 the next morning we were up. We plastered our faces with a thick coating of cold cream and cinema paint. Three inches of snow had fallen during the night and completely obliterated our tracks of the

▲ ABOVE THE sea of clouds that hangs almost incessantly over the lower slopes of El Sangay. Beneath it, the Indians say it rains every day in the year



▲ THE "CHRYSANTHEMUM": a pompon of ice. It was supported by a stalk of ice more than 50 feet in height, the base of which was concealed by the billowing vapors of gas within the crater

▼ TITANS FORMED of ice dotted the glaring landscape up whi the climbers struggled. It was probably in this area that Co mander G. M. Dyott fell into a crevasse and nearly lost his li on his unsuccessful attempt to reach the summit

▲ On the highest point of El Sangay. Dr. Robert Thomas Moore is in the center, his son Dr. Terris Moore, now President of the University of Alaska, is on the right, and Waddell Austin of the University of California is on the left. Dr. Lewis Thorne is taking the photograph. None of the Indians would climb to the top to face the God of El Sangay, whom they feared

previous day. As the surface was frozen beneath, the snow made the going treacherous and compelled us to cut steps with the ice ax, retarding progress. Five hundred feet below the "hummocks," Waddell was struck down with "siroche," the curious mountain sickness that had incapacitated the great explorer Humboldt on Pichincha 127 years before. He lay flat on his stomach, attacked by violent nausea and headache. In accordance with previous agreement, the rest continued, but a half mile from the crevasses I ordered a pause and luncheon of hard chocolate, in order to watch the prostrate form below and determine if assistance would be needed. To our utter astonishment he picked himself up and stumbled toward us. Several times he fell prone on the ice only to rise again. At length he reached the party, and after a long rest and a bite of bread he continued courageously on. Throughout this hour, we had clung to a steep icy slope, with backs to the ice and heels in precarious toe holds.

From the hummocks we veered back toward the north, to avoid the crevasses on the south side of the peak, and took the steep western pitch, even though it obviously would require ice-cutting to the top. The use of the ax proved an increasing effort for persons loaded with cameras, tripods, alpine rope, barometer, and minor equipment. Turns were taken, but progress was slow. After several hours the slope eased up, and at the end of another half hour a soft area was reached where cutting could be abandoned. The large black fumarole, observed from Culebrillas, loomed to our left. We narrowed our zigzags to avoid it and headed directly for an icy ridge above us, from which clouds of white fumes were pouring. Ropes were now in use; they were tightened for the last effort. I took the lead, heading straight for the summit. At 1:15 P.M. we reached the apparent top, to discover we had surmounted the outer crater only. An inner cone from which masses of gas were pouring, rose still higher by several hundred feet. At our feet, between us and the base of the cone, yawned a gas-emitting crevice, which, as it curved to the south and east, widened to the proportions of a gorge. Outrushes of gas obscured the abyss, and its walls were fantastically draped with icy stalactites.

To our left the gorge narrowed. Over this a bridge of ice and snow offered a possible approach to the inner cone. I started across and broke through. The fall stopped suddenly with a thud. My feet were on hot ash below, which had melted the ice on its underside, and my neck was encircled by the surface ice. Scrambling out, I started up the ascent on the opposite side of the crevice. Breaking through the icy crust every few feet, we reached the edge of the inner cone and gazed down into the murky depths of the real crater, which never before had been viewed by the eyes of man!

The rest of the ascent around the frozen rim to the highest point of the southwest rim—the actual summit of the volcano—was easy. Standing there, we photographed each other. We did not know until later that we were really on a shelf of ice, extending out into, and actually overhanging, the abyss of the crater below! It was 1:50 P.M. of August 4th, 1929. Twenty-one days had elapsed since we had started on the trip, and during this time rain or snow had fallen every day, and most of the time every hour of the day! No wonder Lewis seized his harmonica and played a tune of triumph to the defeated God of the Crater. No one but our four Americans reached the summit. The Indians feared to face the "frightful God of El Sangay."

But there was much still to be accomplished if the appearance of the historic crater was to be recorded. Four cameras had reached the summit—an ordinary film kodak, a compur, a motion picture outfit, and a 5 x 7 for recording natural colors. The next three hours were employed in securing photographs of the fascinating phenomena about us. An ultramarine sky arched above us and reached the tone of indigo at the zenith. Slightly below our own level, the tumultuous ceiling of the clouds stretched for endless leagues. They were white when the gases from the crater blew to one side but tinged with gray when they interfered. The snow at our feet on the crater rim was tinted by the fumes, and it impinged on the tongue a nauseous taste like ammonium chloride. Great clouds of the gas interfered with the photographs and at such times took on a dark shade because of their density.

The main axis of the crater ran northwest and southeast. We were standing on the southwest rim, which actually overhung the sheer walls as they dropped into the smoking gulf. The crater must once have been much greater in diameter, perhaps a half mile; but in recent years a new cone had built itself several hundred feet higher into the air, and

Continued on page 286

THE KETTLEDRUM Choir of June

"Jug-o'-rum! Jug-o'rum! Jug-o'rum!" More than any other call, the stirring love song of the bullfrog voices the spirit of the wild and secret world of the marshlands

By BEN EAST

Photographs by the author

IT lasts for about five seconds, rumbling and thundering around the reedy margin of the lake. Then the June night is still, save for the soft wind in the maples and elms, for 20 to 40 seconds. After that the Old One speaks once more and the others join in, and it starts all over again.

It's a deep and vibrant song, like a dozen bass fiddles crying "Jug-o'-rum! Jug-o'-rum! Jug-o'-rum!" over and over again. It's the incarnate voice of the warm nights of early summer, wherever there are marshlands. It's the kettledrum chorus of June, the mating song of the biggest frog in North America, the throaty bellowing by which the bullfrog courts the lady of his choice.

Some frogs croak; the tree frog and the common toad trill loudly and clearly; the tiny spring peeper plays sweetly his Pipes of Pan. But the bullfrog, giant of the tribe, has vocal equipment to match his bulk and his solid, squat appearance. He bellows a resonant, thrumming roar that can be heard a mile or more across fields and water on a still night. It has earned him his name of bullfrog. It is the loudest low-pitched sound to come from the throat of any cold-blooded animal in the United States north of the range of the alligator—and to those who know intimately the lakes and ponds and rivers, and the green jungles that border them, it is one of the most stirring and interesting of the many noises of summer nights.

The time for it to begin, in the lakes and marshes of the northern United States, is in late May or early June. Wild roses are in bloom at the roadsides, white water lilies are opening their immaculate, gold-hearted stars along the pond margins. There comes a warm still evening, and after sunset, when the late-spring dusk is settling over the land, the first bullfrog song of the year rolls up from lake or pond—a thundering kettledrum solo, or maybe a duet, that pulses and throbs and seems to shake the ground itself.

Those who live in the marsh country know then that summer is at hand. That is the unfailing harbinger, the sure forerunner, heralding summer as the first bluebird song and the first liquid notes of the red-winged blackbirds in March foretell spring. In a few more days the clover fields will be fragrant with bloom, the wild strawberries will ripen, the wheat will begin to turn bronze.

As a boy, I lived in a region of ponds and marshes and small lakes,

◄ MASTER MUSICIAN of the marshes: the bullfrog, herald of summer

in southern Michigan. Bullfrogs abounded there, and their singing was as much a part of the nights of early summer as the flight of the fireflies over those same marshes. Countless nights I lay awake in my room under the eaves of the old farmhouse, dreaming the long dreams of boyhood, shunning sleep deliberately that I might enjoy as late as possible the Jug-o'-rum song booming over and over again through the warm darkness.

No sound of the outdoors meant more to me than that throbbing, thrumming music from the lake margins. It spoke of lily beds, of coves where pickerelweed made a blue fringe in the shoals and big bass lurked in their underwater lairs. It hinted at secret bogland nooks where pitcher plants lifted their strange and treacherous urns of death, where showy lady-slippers hid their wine-stained white chalices in the green marsh tangles.

Not many in our neighborhood knew where the pitcher plants and lady-slippers grew, but I knew. They grew in the remote, untraveled thickets of the marsh, and the big frogs were part and parcel of that wild and alien and alluring world. They shared it with bitterns and nesting rails, thick-bodied water snakes and log-sunning turtles.

It was a world that lay literally at my dooryard, yet it was far removed from our upland fields, from the farmlands where we lived. Few penetrated it, few ever came to know its creatures and learn its mysteries, or so at least it seemed to me as a boy. It was a world that drew and held me by its wildness and aloofness, its secret places and its sounds and smells, its sinister wetness and the things it spawned. And to me the bullfrogs were its first spokesmen, its foremost singers, its great troubadours, relating its story, interpreting the spirit of the marsh itself as none of its other creatures did.

For me they still play that role. I moved back a few years ago to that same neighborhood. I live now on the farm where I grew up. And I await the kettledrum choir each summer as eagerly as ever and enjoy it as hugely.

Unlike many frogs, the bullfrog does not sing in unison in a true chorus. Or so, at least, the herpetologists contend. On the other hand, he rarely enjoys the chance to sing alone.

The bullfrog population of a pond, small lake, or section of marsh may consist of from half a dozen to two score or more of the big batrachians. And as often as one starts to sing the others join in, adding their voices to the clamor as if the first concern of each were to outdo all the rest. As a matter of fact, it is highly probable that this is exactly the case. Evidence and reason alike indicate that true rivalry inspires the performance. After all, the song is a courtship ritual, and through a long evening or an entire night the big frogs continue to thunder at irregular but very frequent intervals. Each time the first member of the choir bellows, the others simply cannot keep silent.

I have timed the thrumming chorus many evenings, on the medium-sized lake that lies at my door. They average about two performances per minute, each period of song lasting from four to seven seconds. But the rhythm of the singing is not entirely regular. Even at the peak of the mating season the periods of silence may endure for as long as 50 seconds or may be no longer than 20.

Always it seems to be the same frog that touches off the whole kettledrum orchestra. Whether he is the acknowledged leader and the others await his signal to begin, or whether the entire choir runs out of breath and regains it at precisely the same time and in the same order, I cannot say. The former explanation seems the more logical, however. At least I have observed, whenever I have timed the frogs (and, for that matter, through all the years I have listened to their singing) that almost unfailingly there is one voice that trips the symphony and that the others of the neighborhood follow time after time in the same sequence.

Frog A, on a reedy point at the east end of the lake, may open the number. Frog B, over in the lily cove a quarter mile away, sends his voice thundering forth a split second later. Frog C, down by the inlet, trails immediately, and then the entire group is bellowing in pulsing, broken cadence. Silence falls, and half a minute later they begin all over again, in exactly the same order.

Often there is one dissenter that

➤ ONE FROG touches off the orchestra, and the other kettledrums chime in

insists on keeping out of step, singing his complete song time after time midway of the periods of silence, when no rival is articulate and when he has lake and marsh and all the night completely to himself. It seems there are rugged individualists even in the amphibian world.

In between the periods of deep-toned singing, in the green rushes along the shore, lesser characters will say "Grunk!" over and over again, in voices not without music. They are green frogs, closely related but smaller kinsmen of the true kettledrummers.

Almost unfailingly it is possible to distinguish the voices of individual frogs, especially those of outstanding size. One spring we listened night after night to one that far outbellowed all the others. From the timbre of his song, from both its pitch and volume, we felt sure he must be a frog of gigantic size, a veteran that had survived abnormally long the multiple hazards that beset the lives of all frogs, even the biggest of the clan.

We named him the Old One and came to listen for his thunderous, earth-shaking notes to open the night's performance as dusk deepened over the countryside. His singing area was in a mixed bed of rushes and lilies, on a lake that lies across a narrow neck of marsh beyond ours. A channel wide and deep enough to permit passage with a small boat connects the two lakes.

Finally, close to the end of June, the night for the bass fishing to open came. There would be fishermen afloat in numbers on both lakes once midnight arrived. They would cover each yard of the reedy shallows before morning, and many bass fishermen are addicted to frog-leg dinners. It is a simple matter to take the kettledrummer at night, with club or spear or snag hook, by blinding him with a flashlight as he sits hunched

➤ SOMETIMES HIS worst ene
man who wants frogs' legs f

▼ IN HIS DOUBLE WORLD of air and water, the bullfrog faces danger from both above and below

◄ YOU MAY NOT see him near by but his music resounds far and wide

in shoal water. He can even be tempted into snapping at a bait or artificial fly dangled on a short line in front of his nose.

Knowing these things, and fearing for the safety of the Old One that night, we decided when darkness fell to organize a rescue expedition. Obviously, we could not hope to save all the bullfrogs in the lake, but perhaps we could save that one. And if we moved him to a dense patch of rushes close beside our boat dock, he might escape molestation and survive the whole summer there.

He was easily located, for the night was warm and he was singing powerfully. We rowed through the channel into the second lake and turned down the shore in his direction, making as little commotion as possible. A few yards from him we pushed the boat into the rushes and turned the bright beam of a flashlight his way. We picked up his big, bulging eyes, shining like twin embers, and the squat outline of his head and shoulders lifted above the water. I shoved the boat in slowly until the stern was within arm's reach of him.

He stopped singing, and just as I leaned down to grab him, he took alarm and crash-dived. But the romantic mood of the evening betrayed him in a curious fashion; he was so inflated with air, as an essential part of his tremendous vocal performance, that he could not stay submerged! He drifted to the surface almost immediately and hunched there beside the boat, a badly handicapped leviathan of a frog, a victim of his own ardent mood, unable to escape but unwilling to deflate.

I scooped him in and we took him home. He spent the night in cramped quarters in a bucket. In the morning we took him to the dock and set him free, anticipating with pleasure his vibrant singing at such close range in the nights to come.

But he had other ideas. He had a home range, a singing area of his own, and he proposed to return to it. The first evening we heard nothing from him. But the evening following, exactly 48 hours after we had captured him, he was singing again as lustily as ever—back in the patch of rushes and lilies in the second lake, where we had heard him first. It had taken him two days, apparently, to travel down our lake, through the channel, and along the shore to his chosen location. That he had made it without mishap was little short of a minor miracle.

He sang there the remainder of the season, but he sang alone. We did not hear the voice of another bullfrog on either of the two lakes again that summer. The fishermen had made a clean sweep, it seemed, that first night. But at least our scheme for the safety of the Old One had succeeded.

The bullfrog comes late from hibernation, the males appearing two to three weeks before the females, and they start singing almost immediately after they emerge. With the end of the breeding season, the kettledrum choir slackens and falls silent. It is heard with decreasing frequency after early July in the north and rarely later than the middle of that month.

On the night of July 13 last summer, one persistent choralist was still singing infrequently, at long irregular intervals and by himself, in our lake. Thereafter, we heard the kettledrummers no more. The hot, dry weather of midsummer and the waning of their courtship ardor had stilled at last June's thundering chorus.

No, not quite stilled, after all. For much to my surprise, on a warm and cloudy day on September 16, a bullfrog sang a few times from the far side of the lake. He managed only two or three desultory notes at a time, as if aware of the futility of such things when summer was dying and his own personal year coming to a close. Yet seemingly he could not quite restrain an inner impulse to set the earth trembling one final time with sonorous music before he retired into winter hibernation.

Bullfrog spawning, like that of most tailless amphibians, in the temperate regions, is governed by water temperature. Not until the water is warm enough for rapid incubation, 60 to 70 degrees, are the eggs deposited. Each female produces from 12,000 to 20,000, laying them in large masses at or near the surface, usually attaching them to submerged reeds or other aquatic vegetation. Each egg, half white and half black, is surrounded by a ball of jelly-like material that binds the spawn together in a squarish mass or wide ribbon. The tiny tadpoles emerge in about four days.

The bullfrog tadpole is a dapper and handsome fellow, straw-colored beneath, brownish-green above, with fine yellow dots over all the body and black spots on the tail. He grows slowly, spending at least two years in the tadpole stage, and he will not transform into adult until the third year if his food supply is scant or other environmental factors are unfavorable. Normally the tadpole is about two inches long

when metamorphosis occurs, but in extreme cases he may attain a length of more than five inches before quitting the water for the shore. The transformation usually takes place in July or August. Another five or six years must then pass before the frog reaches maximum size, at which time, if he has lived well, he will boast a body length of six to eight inches, an over-all length of almost double that.

As a tadpole he feeds principally on algae and other vegetation, taking in addition a few small aquatic insects and other animal food. As an adult frog he turns entirely carnivorous, and his taste is cosmopolitan in the extreme. Although his principal fare consists of insects, small crawfish, snails, worms, and spiders, he will take almost anything his capacious jaws can close upon, provided it is not more than his match in one way or another.

Often falling victim himself to a big bass or pike, he does not hesitate in turn to gobble up any fishes small enough to be swallowed. The water snake is one of of his most dread enemies. As often as a suitable opportunity presents itself, he pays his debt to the reptile clan by capturing and swallowing any snake that comes his way and is small enough to be vulnerable. He must live in constant fear of the big, vicious turtles that share his warm-water shoals. Yet little turtles are often found in his own belly. Herons and bitterns are among the deadly perils of his world. He evens the score by pulling under an occasional unwary wild duckling, young coot, or other water bird. He is not above snapping up other frogs smaller than himself.

He lives in a ruthless, murderous world at the margin of pond or lake, a place where marsh and water meet and death can come from overhead or underneath with equal swiftness. The law of that world is eat or be eaten, kill or perish. And for all his warm and vibrant love song, for all his harmless and even dull-witted appearance, for all the benign demeanor of his big protruding eyes and the upturned corners of his wide, comic-character mouth, the bullfrog is without mercy where things smaller or weaker than himself are concerned. He is a cold-blooded and efficient hunter of the shoreline jungles, rush beds, and the lily thickets, as he must be to survive.

But to those for whom the marsh has allure, he is foremost and above all else a musician of early summer that has no peer.

Professional frog hunters, taking him for market and for their own tables, all but wiped him out on the lakes where I knew him long ago, between my boyhood and the time when I returned to that same country years later. But the bullfrogs are making a comeback now, and I am glad. They are a part of the marsh country that should not be lost — sturdy, outdoor characters well worth protecting and preserving. If you have not heard their resonant, sonorous music in the warm and fragrant nights of early summer, you do not know all the fullness of June.

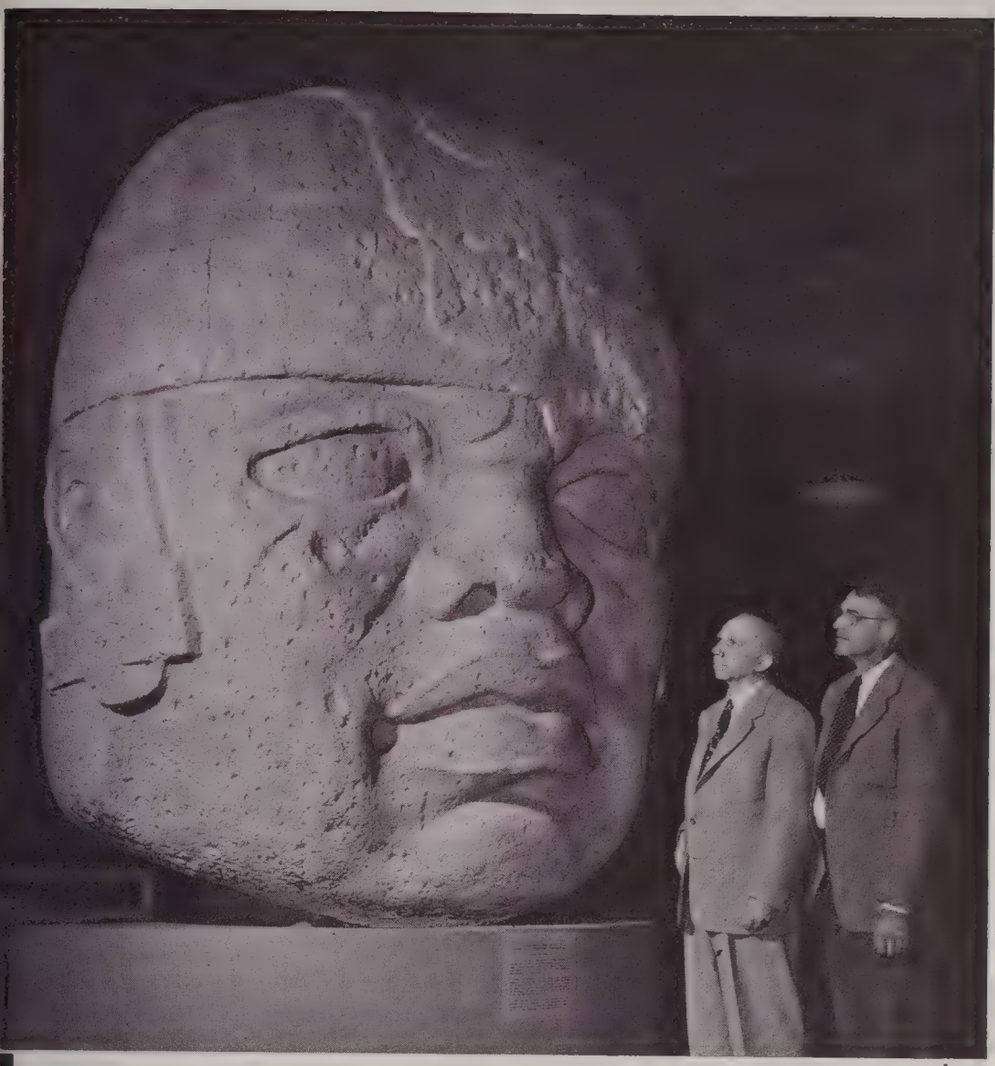
CARPET BEETLES *Continued from page 263*

seum Beetle (*A. museorum*) is one of the few members of the family that shows a preference for dried plants, and its depredations have destroyed many valuable herbarium specimens. Of course, it will also attack most other things that carpet beetles like.

The Furniture Carpet Beetle is a rather recent settler in America, having first landed and become established in this country less than 50 years ago. Its feeding habits are quite peculiar. While it will attack most animal products, it will starve to death on a diet of pure wool. But if the wool is dyed, it can reach maturity. For the most part, it confines itself to the interior of furniture and chairs. Its chief stronghold in America is in Washington, D. C., where it has developed into a serious pest. In other parts of the country, the damage done is sporadic and occurs chiefly in the homes of the wealthy. The Furniture Beetle does not make any effort to select opulent homes; rather, wealthy people unwittingly select the beetle. Almost all the isolated but numerous cases of damage by this beetle have probably been the direct result of importation of antique furniture from Europe or adjacent regions. In the two serious infestations that have come to my attention, this was obviously the case.

The first of these was located in Virginia, where two pieces of furniture were heavily infested. Here, the larvae confined their feeding to the stuffing, and they might have continued to flourish there for many years had not the adults made a nuisance of themselves by coming out and swarming about the windows in an attempt to reach the outside. In this beetle at least, the adults do not need to feed in order to reproduce; they can continue for innumerable generations on the inside of a piece of furniture, the owner entirely unaware of their presence.

The second infestation was near New York City and was extremely severe. Most of the furniture was of European origin. It was not possible to determine when the beetles had arrived in the house, but for several years the adults had been increasing greatly, and at the time the examination was made, thousands of them were present. The larvae had overflowed from the furniture to the rich carpets, which in many places were honeycombed. Beneath many of the pieces of furniture large patches of the rugs had been eaten away. Not a room in the house was free from adult beetles. They were in the furnace room, trying to get out through the glass window, and in a large storage room in the cellar they were swarming over everything. Their breeding place may have been in any one or all of several dozen pieces of furniture. On the first,



Acme

"THE KING"

The largest stone head ever found in the Western Hemisphere

THIS reproduction of the largest carved head ever found in the New World now dominates the Mexican Hall of the American Museum of Natural History. The head is 9 feet high, 6 feet wide, and 20 feet in circumference. It is believed to have been carved at the beginning of the Christian era.

The original head was discovered near San Lorenzo in the state of Vera Cruz by Dr. Matthew W. Stirling, Leader of the National Geographic Society-Smithsonian Institution Expedition to Southern Mexico. In 1947, the American Museum sent Dr. Gordon F. Ekholm, Associate Curator of Anthropology, to Mexico to make arrangements for reproducing it. The head was cast in plaster, and 52 sections were transported from the jungle in river boats and shipped to Mexico City, where 16 large sections were cast. These were shipped to the American Museum's Department of Preparation, where they were assembled and the finished reproduction completed.

The name by which this magnificent sculpture is known, El Rey ("The King"), was given by the native workmen, who were impressed by its huge size. Today the original head still lies in the jungle where it was found. It weighs fifteen tons, and the task of transporting it would be tremendous. One of the mysteries of El Rey is how the ancient people were able to move it nearly 60 miles over rough country from the place where the stone must have originally been quarried.

Living long before the Aztecs, the ancient people of the Olmec country who carved the head may have been contemporaneous with the early Mayas and represented the earliest high culture in the New World. Artists and sculptors who have seen the reproduction call it a great and outstanding work not only of early Mexican art but of any period of culture, particularly since it was carved with stone tools.

second, and third floors, there were dozens of them around each window. The linen closets and other storage places upstairs had their quota.

The amazing thing about this infestation was the relatively small amount of damage that had been done. Had the Black or the Buffalo Carpet Beetles been present in such numbers, there would have been little or no undamaged materials of animal origin left in the house. The condition inside some of the infested furniture must have been appalling, and I have often regretted that I did not open some of it to see just how thoroughly the stuffing had been chewed.

Special Control

In many instances the control of unusual infestations of household insects requires special treatment. Here is an outstanding case of this kind. The problem was to devise a proper kind of spray that would have a number of characteristics. It had to be sufficiently volatile and penetrating so that its fumes could be forced into cracks and crevices and into the furniture itself. It must leave an endurable killing residue. It must not bleach or stain the most delicate fabrics. And it must be fireproof. The last major con-

sideration was safety to warm-blooded animals, including the men and women in the house.

Every commonly used insecticide, solvent, and diluent was considered. A few hours of deliberation with Mr. V. B. Durling resulted in a spray combination that should have all the qualifications desired. Several methods of application were considered, and what proved to be the proper one was decided upon. We had relied upon a lot of theory in evolving the spray. We knew that only a rigid test would prove its value. The logical place to make the test was in the most heavily infested place in the house—the basement storeroom. When, 48 hours after spraying, there was no sign of insect life in the storeroom, and no materials, including many delicate things that had been placed there especially for the test, had been damaged, the rest of the house was treated. The instance cited above is an unusual one, since the infestation was of a rare type.

General Control

All of the methods used for control of clothes moths have been employed in an attempt to prevent damage by carpet beetles, but, unfortunately, carpet beetles are much more difficult to kill than clothes moths. Whereas the clothes moth larvae may be killed by dichloricide fumes in five to twelve days, the beetle larvae may require from ten days to three weeks.

Naphthalene and camphor have little effect on the development of larvae, but these materials do prevent egg-laying.

Cold storage is a big help in controlling carpet beetles, but it does not necessarily kill the larvae. Rather, it drives them into hibernation. Even the Furniture Carpet Beetle can probably survive the winter out-of-doors in the southern half of the United States. The larvae are probably able to go without food, at low temperatures, for as much as six months, and at temperatures above freezing they probably nibble a bit. However, damage at temperatures below 40 degrees F. would be negligible.

Hanging household materials in the sun is usually not very effective. The larvae merely crawl to the darkest and coolest place and stay there until the materials are returned to the house or until the sun goes down. However, if the materials are brushed at the same time, the pests may be eliminated. Frequent examination of stored materials and spraying of the containers, inside, will prevent serious infestation.

DDT, Chlordane, or deodorized Benzinehexachloride (BHC), used in the proper solutions and properly applied, will give protection. I prefer a one per cent emulsion of any one of these, which can be forced by pressure into rugs and carpets and into the cracks of floors and walls. In the treatment of furniture, oil carriers should be used, especially if it is necessary to force the material into the interior of the article to be treated. Such sprays should contain a material to eliminate fire hazard. Fumigation in a vacuum chamber will kill all life in household furnishings that can be so treated, but it will not prevent reinfestation. It is not possible to control well-established carpet beetles with the type of spraying done by the average householder, who makes a few passes with a small gun in a clothes closet or on the surface of carpets. Carpet beetle larvae are tough customers, and it takes a lot more than that. A household gun usually holds a quart or so of spray; to do a real job against the carpet beetle you'll need from five to twenty gallons, and you'll have to apply it thoroughly. If you have carpet beetles in your home, you can figure upon about two gallons for each room, with two or three sprayings a few days apart.

Never spray anything until you have tested the material with a small amount of spray on a very limited area, to be sure that the color will not run or that the material will not bleach. Some of the new paints become spotted or run when certain sprays are used. Fur coats may lose their luster or even their color if not protected from direct spraying. Unless materials sprayed with emulsions, and often with oil bases, are thoroughly clean, they are almost certain to be stained.

There have been many cases where dyed furs and carpets have been ruined by a too liberal application of an oil spray. Usually, when staining results from the use of an emulsion, the stains can be removed by shampooing or surface cleaning. A rich suds is made from any light soap or soap powder; and a soft cotton or woolen rag is wet and squeezed until no water drops from it. The stained areas are then rubbed with light pressure until distinctly wet but not soaking. After a few minutes, the dampened surfaces are once more gone over with a soapless rag that has been soaked in clean, warm water and squeezed until almost dry. This is to remove all trace of the soap, and it may be necessary to repeat the process. If a ring still persists around the treated area, a slightly moist cloth soaked in a weak suds solution should be brushed lightly around the ring of stain, to be followed by vigorous rubbing with a dry cloth until no sign of the ring remains. The cleaned part of the rug will be apparent for a few weeks, but its color will gradually blend with the rest.

I have found that an electric lamp shade treated with DDT is effective against carpet beetles as well as clothes moths*, but it is much slower in its action. Carpet beetle larvae are generally very much more resistant to poisons, and it may be two or three months before they are eliminated from a clothes closet in which the shade is used.

Something to remember: If you mothproof a rug, blanket, or clothing with a water solution, laundering will remove the protective substance. If you use an oil solution, dry-cleaning will remove it.

Insect control in the household is a real problem, but if properly employed it will save money and bring real peace of mind.

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*See "Clothes Moths," by C. H. Curran, NATURAL HISTORY for September, 1949, page 330.

AMNH photo

▲ EUROPEAN BLACKCOCK: an extraordinarily well-composed and stylized water color. In the words of one authority, it makes most of the contemporary bird artists look like amateurs. This painting was completed 122 years ago

An Unpublished Audubon

By HAZEL M. HUNTER

JOHN JAMES AUDUBON was residing in London when he made this water-color drawing of two European blackcock. We believe this to be the first time that this little-known drawing has ever been reproduced. The original measures 18⅞ x 27⅝ inches and is signed at the lower left "J. J. Audubon 1828."

At that time Audubon was working with Robert Havell, Jr. on his publication of *The Birds of America,* and he presumably refers to this drawing in his "Journal" under the date of August 9, 1828, when he states:

"I wished again to try painting in oil . . . and have now before me eight pictures begun, but not one entirely finished. One of these pictures is from my sketch of an Eagle pouncing on a Lamb . . . Another is a copy of the very group of Black Cocks, or Grouse, for which Mr. Gally paid me £100, and I copy it with his permission . . ."

Since acquiring the drawing at an auction held in New York in May, 1949, we have endeavored to trace its history. The former owner was the late Mr. George H. Stuart III of Philadelphia. A member of Mr. Stuart's family very kindly informed us that the drawing was purchased by Mr. Stuart in London in 1924 from Henry Sotheran Ltd. Our inquiry to the Sotheran firm as to when and where they secured the drawing has brought a disappointing reply. Most of Sotheran's old records "were destroyed during the bombing of London," and no present member of that old firm remembers how they came by the drawing.

We like to think that when Audubon made our drawing of the male and female blackcock as well as others of European birds, he had in mind the publication of a series of drawings covering The Birds of Europe, which would be a companion to his now famous elephant folio edition of *The Birds of America.* We do not know what The Great Birdman had in mind 122 years ago except an unending interest in birds. We can be sure of that because his ever-courageous, steadfast, and helpful wife Lucy once admitted in a letter to her sister Eliza, "I have a rival in every bird."

Jumping Fishes

By Bucky Mc Donnell

WHILE talking to an old-time fresh-water fisherman, I mentioned that I could catch fish without a rod, line, bait, or cuddling. To my surprise, my friend looked perplexed and asked if my method was by traps, nets and snares, or shooting. "You haven't guessed it," I said, "so you probably don't know how to make fish jump out of the water."

The fisherman replied that, although he trusted my honesty, I'd have to show him my magic before he'd believe it. I was surprised that an experienced fisherman had not heard of this simple trick; but several other men who studied fishes scientifically were likewise unfamiliar with it.

I met my friend on the date set for a demonstration and spent the day swimming and hiking around Lake Tiorati, along the Appalachian Trail, where I have a shack. Every now and then he would impatiently ask, "How about the fish jumping out of the water? What are you waiting for?" My answer was the same all day: "There are too many people in the lake." I couldn't tell him why this was important to the success of my method, but I was certain it was. Despite my denials, he persisted in taking this loose explanation as evidence that I wanted to protect my secret.

Finally, evening came, and most of the people and boats cleared off the lake. As we pushed offshore in my canoe, my friend asked if I weren't going to take anything besides the paddles. I laughed, knowing he was sure that I planned to catch the sleeping fish with my hands. I could only assure him that, sleeping or not, the fish would jump and that he would be able to catch them.

I had paddled about three-quarters of a mile out into the lake when I cautioned my friend to be as quiet and as motionless as possible. It was now early evening. The sun was low, and the lake was like a mirror. As far as I could see, we were the only people on the lake.

I paddled hard, making sure not to strike the canoe or move my feet. Then I let the canoe glide to a standstill. I raised my paddle horizontally, about three feet above the gunnels, and then brought it down with a sharp rap across both gunnels at the same time. My friend sat amazed. As many as 200 fishes—pickerel, perch, catfish, bass, and others leaped clear out of the water all around us—some as high as two and a half feet and close enough to be knocked into the canoe. Those closest to the boat jumped the highest.

As I paddled for shore, I waited for a word from my friend. In a moment he said, "Bucky, I will believe anything you say from now on. This is certainly a strange thing. Will they jump again?" We repeated the act on the way to shore, and a few leaped out of the water close to the boat, but the response was not nearly so great as the first time.

My friend believed, as I do, that the sudden vibrations set up in quiet water react in some way on the fish's nervous system, causing the ones near the surface to break through.

My son and daughter have also helped me demonstrate this action to many nonbelievers.

THE FIRST ASCENT OF EL SANGAY

Continued from page 277

millions of tons of ash had encroached on the orifice until it was not over 800 feet in length. Normally the temperature must be colder than the day of our ascent, for not only was the entire rim sheeted with ice, but huge masses of it, as well as snow, had developed on the lower northeast side, and an astonishing amount of huge icicles depended from the overhanging southwestern rim. Other mounds of snow and ice had accumulated far down in the crater at points where the heat was less intense.

I pointed my camera into the cavern and waited a half hour for the gas to blow to one side, in order to record the curious ice hummocks extending into the depths as far as visibility might permit. The northeastern rim of the volcano was broken down for a distance of 200 feet. Through this portal, lava undoubtedly had poured at some period of the past and plunged down the steep slope into the Amazon basin three miles below. We made a circuit of the rim to the northeastern break in the wall. Here the descending knife-edge had frozen solid and proved too steep for snow to collect. We dropped toward the bottom of the crater by straddling and sliding but could not go far because of the gases.

On this lower side the beauty of the orifice reached maximum. Across the vortex rose the sheer wall we had just left. Its rim bulged with overhanging ruffles of snow, outlined sharply against the indigo sky. Below were the ebony walls of ash, patched with snow areas. Out of the depths at our feet, its base lost in the swirling gases, rose a strange formation, which rounded out into a perfect white chrysanthemum 50 feet in diameter and of unknown height. Its foamlike top glistened in the rays of the western sun. Interesting as was the gas-veiled floor of the crater, exquisite as was the frosted rim and the "chrysanthemum," nothing could equal the sublimity of the ice formations which had reared like blown spume of the sea over the southeast margin. Fantastic shapes predominated, huge and chaotic. As we faced to the north a simultaneous exclamation of astonishment broke from the lips of all. In the distance, ten degrees east

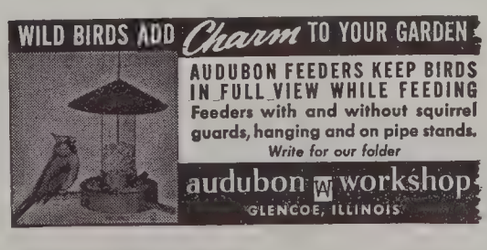
of north, two gigantic fingers had etched themselves in glittering white above the billowing cloud masses. From the summits of her great candles, the unclimbed mountain El Altar had witnessed the conquest of her far-famed rival.

Climbing for the most part on our knees, we reascended the frozen eastern knife-edge to the northeast rim. A sudden blast from the prevailing east wind blew the Shroud back momentarily over the Labyrinth to the west and exposed one of the longest, almost perpendicular descents in the world—over three miles. The mystery of the constant renewal of the Shroud was revealed before our startled eyes. Far down in the superheated Amazonian cauldron, white puffs like mushrooms were continually forming. Humid currents of air were being forced upward by the tendency of heat to rise. Ascending the 18,000-foot slope, they entered the frigid atmosphere about the ice fields. The contact of heated currents with freezing temperatures results in rapid condensation, and clouds are born in a moment before the astounded eyes of the climber. This process keeps up for days, the ever-oncoming masses joining the Shroud to the west and constantly recreating it. The new clouds congeal on the slopes and thicken the collar of snow and ice. When El Sangay blows off its cap, the ice field dissolves rapidly, and the Labyrinth at its base is choked with a stupendous deluge of water and ice cascading down the precipitous sides. The flood boils and churns in the gorges, and masses of ash, catapulted out of the crater, choke the canyons and destroy every vestige of plant life. Indians who have ventured too far to obtain their delectable tapir are then caught in a trap. But the roots of the formidable sword-edged plant known as "paja" survive on the crests of knife-edges between the canyons and soon reclothe the ridges and plateaus with formidable clumps, two to five feet high.

We dared not linger longer! At 4:50 P.M., we said farewell to the inner rim. Then did the mountain witness a sight that would have delighted the hearts of the Scandinavian gods. In a gesture of exultation, the boys threw themselves into a glissade down the steep southwest slope. As their sliding, prone forms took on speed, momentum whirled them down the ice, and they disappeared in the flung spume of the snow. In 30 minutes they reached the fiala tent, a distance that had required 5 hours and 10 minutes to cover on the ascent!

The rest of the descent under the Shroud and the return to Alao were accomplished without much difficulty. The party suffered considerably from a continued diet of raw venison and sugar. Two of our Indians, while trying to recover the tent and equipment from the snow line on a midnight of storm, fell off a knife-edge and were rescued in a hysterical condition by Terry and Lewis. The rivers in the Labyrinth had risen above their previous flood levels but not sufficiently high to prevent threading a course through the canyons. Thenceforth the peons treated us as heroes and helped to make the return easy for the "Mad Americans" who had braved the wrath of their dreaded Demon. *We* dreaded far more the incessant rains, which continued unabated day and night, until we finally emerged from the cloud to the Valley of the Alao, there to lie prone for one hour of ecstasy under the balm of our own god—the Sun.

Only twice had the Shroud been rent during the return, once on Dorado Mountain at the twilight hour. It was the final view of the mountain we had learned to love. The last shafts of sunlight had long left the valleys, when the Shroud parted and revealed the God of Snows in a mood of sublime ecstasy. He had girdled his thighs with a band of royal purple and his chest with an ermine collar. But his head stood clear in the afterglow, flushed with beneficent gold. El Sangay was putting all the kindliness of a majestic being into one last farewell.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Walton; he recounts the whimsical behavior of trout, he expounds upon the appeal of various lures, and finally he describes how trout should be cooked. Surely, every office-bound reader will wish to follow the example of Justice William O. Douglas.

H. E. ANTHONY

NATIVE ARTS OF THE PACIFIC NORTHWEST

Introductory Text by

- - - - - - - - - Robert Tyler Davis

Stanford University Press, $7.50
166 pp., 194 photos, 5 color plates, 1 map

IN recent years one notes an ever-increasing tendency on the part of art museums to recognize the carvings and paintings of the Northwest Coast Indians as representing one of the world's great art traditions. It is gratifying, therefore, that so handsome a publication should have been devoted to this subject, heretofore largely unknown to students of the fine arts. In this photographic album, the first of a series of art books projected by the Stanford University Press, the fantastic productions of the Northwest Coast artist-craftsmen stand on their own merits and speak eloquently for themselves. The unity and uniqueness of the North Pacific tradition is immediately apparent, and it contrasts strikingly with the few Eskimo examples that have been included. In addition, Dr. Davis' text, though brief, is pertinent and provides the cultural setting against which the objects take on added meaning.

Nearly all of the examples illustrated were selected from the collection made by the late Axel Rasmussen of Skagway, Alaska. Considering the money, time, and effort expended on this lavish volume, it seems a pity that the editors should have so limited themselves, however outstanding this body of material may be. One result is that certain of the major classes of wood sculptures—house posts, grave monuments, and the so-called "totem poles"—receive almost no representation. Another is that some tribes, particularly the Tlingit and Kwakiutl, are emphasized at the expense of others, while certain important groups like the Nootka are not represented by a single specimen. In addition, although most of the objects have considerable eye appeal, some pieces are simply not of the highest caliber. The present album, however, is a significant contribution in the field of fine arts. The careful documentation, as well as the fact that the collection has not been illustrated previously, should make this volume of interest not only to the layman but to the professional anthropologist.

H. T. TSCHOPIK, JR.

nervous, and after my last shot he took off through the trees at a fast walk.

JACK W. LENTFER.
Livingston, Mont.

* * *

SIRS:

Congratulations on the Fiftieth Anniversary of your distinguished publication, NATURAL HISTORY, and best wishes for every continued success . . .

JORGE A. LINES.
San José, Costa Rica

* * *

SIRS:

. . . I want to congratulate the Museum most sincerely on the Fiftieth Anniversary of the Magazine, and the Editor on the article, "It's for You to Choose." . . . When you pass near the Hayden Planetarium, you ask yourself perhaps the same question as Nick Kenny:

"How can you look at a sky
full of stars
And say there is no God?
How would the flowers know
it was spring
Except for a smile from God?"

This is felt by all humanity, be it "black, white, yellow, red, each in his Maker's image." It is high time to reach out and give a helping hand to each other . . .

W. DEININGER.
Puerta La Laguna,
El Salvador

* * *

SIRS:

I have read with interest that NATURAL HISTORY has been in existence 50 years. I send you my best congratulations and most respectful greetings. If men studied nature profoundly, we would have no wars and would praise God for his ingenious works . . .

EDUARD ESPENSHIED.
Ludwigsburg, Germany

* * *

SIRS:

. . . Your splendid editorial, "It's for You to Choose," . . . is an excellent presentation and very thought-provoking.

IRVING M. IVES,
Senator from New York
Washington, D. C.

* * *

SIRS:

. . . As a member of the Museum for many years, I take pleasure in congratulating you on the Fiftieth Anniversary of your excellent publication . . . I think that your editorial "It's for You to Choose" was one of the finest things I have read in my life, and of course I am saving it . . .

ANTHONY V. RAGUSIN, *Sec.*
Biloxi Chamber of Commerce
Biloxi, Miss.

Important Notice

Readers are reminded that NATURAL HISTORY is not published during July and August. Those who expect to be away after September 1, however, and wish to have their September issue sent to a temporary summer address are requested to notify the Membership Secretary. Please give also the date of expected return to permanent address.

The Planetarium Show

"Color in the Sky" will be the subject at the Hayden Planetarium during June. The presentation will include the northern lights, rainbow coloration, and related phenomena.

During July and August, visitors to the Planetarium will take an imaginary trip to the Moon by space ship. Landing in a lunar crater, the audience will explore its many strange wonders and view the earth from a new point of perspective in space.

Special

Exhibits at the American Museum

Until June 16

Second Annual Exhibition of The New York Entomological Society.

June 9—July 4

Design Down Under

An exhibition comprising 22 photo mural panels dealing exclusively with the art and design of the Australian aborigines. Shields, bark paintings, tattooing, baskets, flint knives, axes, clubs, bull-roarers, sacred stones, paddles, and headdresses are some of the many kinds of designs shown.

June 15—July 30

National Soap Sculpture Exhibition

July 7—July 31

Old Flower Prints

A collection of old botanical prints assembled by Kennedy and Co.

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msel Fly's Debut • Basutos • Salamanders • Geysers

ME LIX, No. 7

Now Ready!

AUGUST ON FIRE ISLAND BEACH

BY ROBERT CUSHMAN MURPHY

(*author of* LOGBOOK FOR GRACE)

This new enlarged edition was published again by popular demand. Dr. Murphy combines an effortless style, grace of manner, and sympathetic understanding of natural history in all its relational aspects. Among other subjects, the author discusses:

Point o' Woods

Its unique charm and simplicity almost within the shadow of Manhattan's skyscrapers.

Beetles and Biters

The insect population on Fire Island with emphasis on tiger beetles and stable flies.

The Turbulent Life of the Sand Bug

Being an interesting history of the life and times of *Emerita talpoida.*

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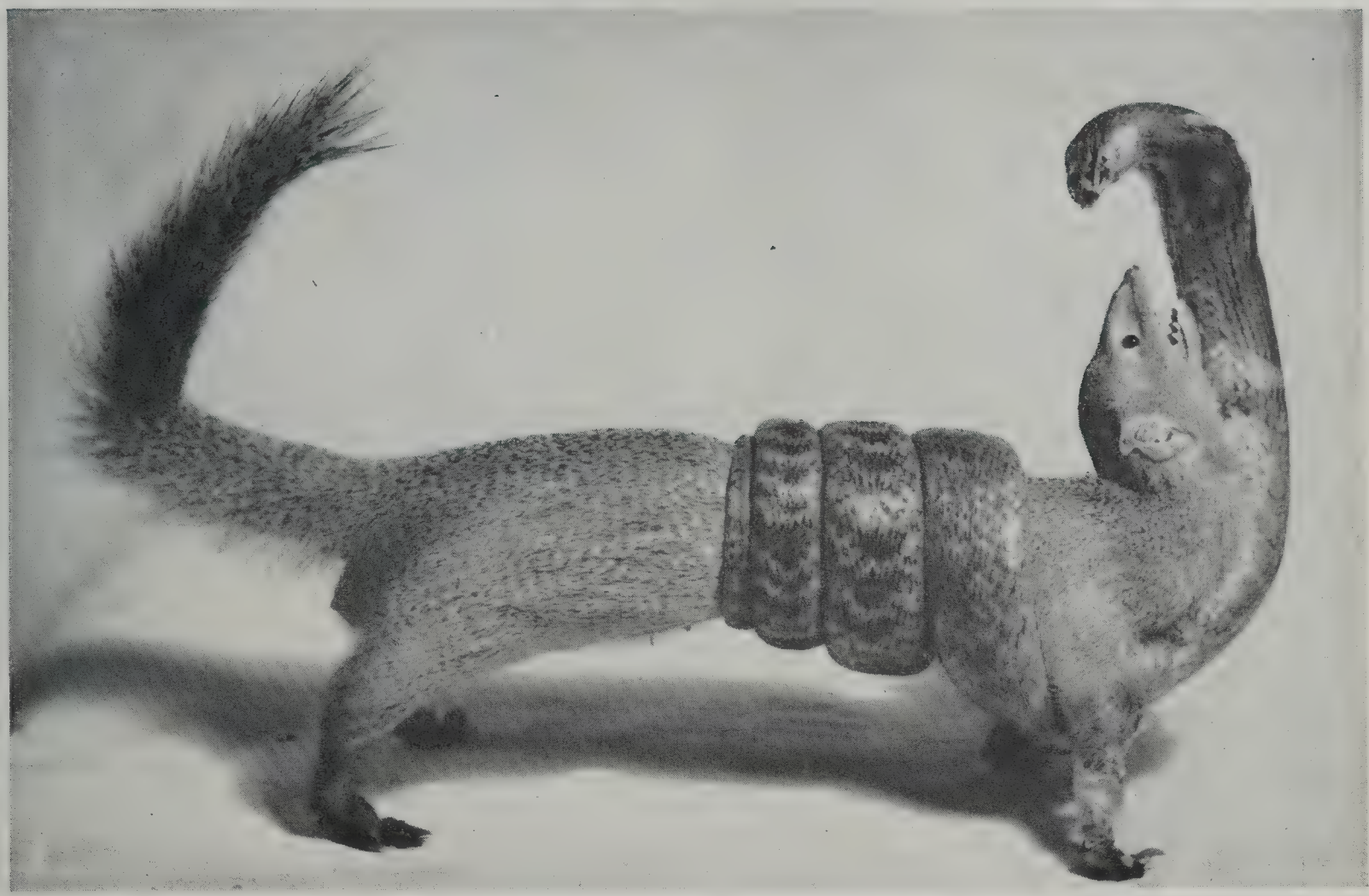
LETTERS



The Mongoose and the Cobra

SIRS:

I would like to know whether the pose depicted in this photograph of a mounted mongoose and spectacled cobra could ever happen in real life. This exhibit is in our Quaker Hill Museum of Natural History at Pawling, New York, and I have seen published photographs of at least one other similar mounting. As the cobra is a poisonous snake, why should it wrap itself around the mongoose? And how could the mongoose be standing firmly on its feet with a snake wrapped around its middle? I suspect that these specimens are the product of an imaginative taxidermist.

Also, what is the plural of mongoose? And is the mongoose always victorious?

MRS. R. M. GUNNISON.
Pawling, New York.

The following answer is offered by Charles M. Bogert of the American Museum's Department of Amphibians and Reptiles:

Mrs. Gunnison's comments on this mounting are quite to the point. I have seen a similar picture elsewhere, in which the snake's neck was firmly grasped in the mouth of the mongoose. The caption read, "Victorious mongoose polishes off a cobra," but the photographer had quite obviously trained his camera on a mounted specimen.

In the course of combat, a coil or so of the cobra may accidentally be wound around the body of the mongoose. Indeed, one of Dr. Thomas Barbour's photographs in his interesting little book, *Reptiles and Amphibians, their Habits and Adaptations,* depicts the live mongoose lying on its side with two coils of the cobra encircling it, one near the legs and the other near the head. Even were the cobra a constrictor, it would be unusual, to say the least, for it to wrap four or five coils around an attacker. Boas, bullsnakes, and kingsnakes that kill by constriction rarely employ more than two or three, and the hind part of the body and the tail are not ordinarily wrapped around an adversary. The positions of the snake and the mongoose in the photograph must therefore be attributed to the fanciful but misguided notions of the taxidermist.

The mongoose may kill an occasional cobra, but it does not seek out such prey. It devours birds, their eggs, lizards, and insects. While he was in China, Clifford Pope tested the behavior of the mongoose and the cobra on two occasions. Once he used a five-foot snake and a small mongoose, and later a three-foot cobra and a large mongoose. When placed together in a small room, each animal apparently regarded its opponent with considerable caution, concentrating its attention on the other. In both tests, the mongoose attacked the cobra at the moment it struck, biting at the snake's open mouth. The jaws of the two were repeatedly interlocked, although the mongoose sometimes avoided the relatively slow strike of the cobra by merely shifting its head.

The small mongoose failed to kill its enemy. However, Mr. Pope knew that the mongoose was in a weakened condition when brought to him, and it died the second day after the fight. The larger mongoose killed the smaller of the two cobras and showed no ill effects from the encounter. During the combat it repeatedly approached the cobra and then lay on its side just beyond its reach. In this position, it kept its vision fixed on the snake, raising its head from time to time to keep it in view—"a most peculiar and inexplicable behavior," as Mr. Pope remarked.

Is the mongoose always victorious? Under some conditions in captivity it obviously is not. In its native habitat, it probably does not often attack an animal it cannot subdue. On occasion, an acute hunger drive may lead it to abandon its

normal caution. But most animals, whether from learning or instinctively, are not ordinarily prone to attack the sort of prey that cannot be overcome. Mistakes are doubtless made, however.

The plural is "mongooses," not "mongeese." These animals belong to an Old World family related to the weasels, badgers, and skunks. What is usually spoken of as the common mongoose inhabits southeastern Asia, from southern China to India. Closely related animals are of widespread occurrence in Africa, and some of these are called mongooses. Incidentally, it may be added that, owing to their destruction of game and poultry, a law has been passed many years ago prohibiting the importation of live mongooses into the United States.

Can Birds Tell Time?

SIRS:

I wonder if the English sparrows in my city garden have a sense of time. About a year ago, I discovered that they like to eat rice. Since then, I have scattered a small amount of rice grains just outside my kitchen door each day around noon. While at other times I occasionally see a single sparrow hopefully searching in the feeding area, there is a distinct difference at noon. Then, as I look from the window, there are always several sparrows watching near by, apparently aware that it is feeding time. There is a restless excitement and expectancy among them. At the sound of the kitchen door opening, they all fly a little farther away, but as soon as I have put out the food and entered the house, a dozen or more return immediately and begin feeding eagerly. In a short while the feast is over, and the entire flock flies away until the next day near noon, when the performance is repeated.

Can birds tell time?

HENRIETTA SCHROEDER.

Woodhaven, N. Y.

The following comments are offered by Dr. John T. Zimmer, Curator of the Department of Birds at the American Museum:

There is little doubt that birds have what, for want of a better term, may be called a sense of time that can operate to induce some particular action at a certain point in a daily rhythm. Many of a bird's activities are governed by such automatic trigger mechanism. A rhythm is established in which various related activities follow each other in regular order. Each completed stage presents a new stimulus that releases the following reaction until the cycle is completed. If the order is broken or interrupted, the bird may be quite confused, perhaps perform some useless action whose normal stimulus is suggested by the situation, or perhaps go back and start over. This type of behavior is particularly noticeable in the activities of feeding the young, where the same maneuver is repeated at frequent intervals. These do not, however, necessarily involve any fixed time of performance.

Other activities may, on the other hand, have a fixed time-release. A tropical wren was recorded as beginning its morning song at a relatively fixed time, and although the intensity of light may have had some influence on the release, it was far from governing the action. Again, a male pigeon has been reported as accustomed to relieve his mate at the nest at ten o'clock each morning. The habit was so fixed that when the female was killed by a cat the male neglected the young (which consequently died from exposure) until his scheduled hour the following day.

The sparrows were, in effect, trained to being fed at a particular time of day, and an internal rhythm had become established with reference to food at that period in the day's activities. Whatever the internal mechanism may be that would spring the alarm, when the signal was given, the proper action followed quite automatically.

There is a nice opportunity for someone to make a detailed study of timing by birds, and the results would be of considerable interest. As far as I know, no one has yet concentrated on the problem.

A Lesson for the Laggard

SIRS:

The accompanying picture shows an unusual-looking animal that I discovered on a shelf in my garage. The little pig had been tucked away on the shelf for some time, and you can imagine my consternation when I first glimpsed the decorations that had been added by a mud-making wasp.

Tulsa, Okla. LAURA M. CLARK.

Suet-storing Nuthatches

SIRS:

Last winter we became much interested in observing a White-breasted Nuthatch that had been coming to the crotch of a sugar maple tree next to our house where we had been placing a piece of suet. On New Year's morning, we noticed that the Nuthatch was picking into the suet quite freely, and when it had a full beak, it would deposit this

Continued on page 336

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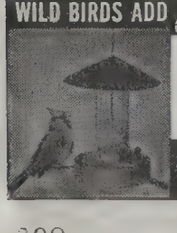

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VOLUME LIX—NO. 7 **SEPTEMBER, 1950**

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You will find Natural History Magazine *indexed in* Readers' Guide to Periodical Literature *in your library*

THE COVER THIS MONTH

The Tarascan village of Angahuan is now the nearest populated community to Mexico's new volcano Parícutin. The wooden homes with their steep shingle roofs are typical of the region. The people are a happy, friendly lot, whose co-operation has gone far toward making the joint Mexican-American study of the volcano a success. For the little girls, the burdens of motherhood begin as soon as they are big enough to carry little brother or sister in the *reboza,* which is the usual attire of Mexican girls and women.

The people of Angahuan have been hard hit by the eruptions of the young volcano. Repeated ash falls have smothered the crops in the fields and killed the grass on which the cattle grazed. Though unspectacular, their plight is serious. Cultivation of the slopes from which the ash has already been washed is only hastening the day when further erosion will make it no longer possible to raise food near the village. While they would undoubtedly cling to their homes as vigorously as did the residents of San Juan and Parícutin, resettlement may ultimately be their only solution.

Frederick H. Pough

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The American Museum is open to the public every day in the year without charge

The Audubon Bird Modeling Kit

A hobby kit for the winter months for young bird watchers and craftsmen. It contains 6 wooden blocks roughed out by jigsaw for carving robin, bluejay, goldfinch, mallard, pheasant, and Canada goose. An X-acto knife for carving, sandpaper for finishing, and paints are included, plus an instruction booklet for the inexperienced. *$2.95 plus 15¢ postage*

Books on Birds

TROPICAL BIRDS
By John Gould *$1.50, postage 8¢*
A selection of sixteen full-page illustrations by Gould, in color.

THE ILLUSTRATED ENCYCLOPEDIA OF AMERICAN BIRDS
By L. A. Hausman *$2.49, postage 8¢*
All the 1422 species and subspecies of North American birds are fully described with a field guide for easy identification. There are over 700 illustrations, including sixteen pages in full color.

BIRD ISLANDS DOWN EAST
By Helen Cruickshank *$3.00, postage 8¢*
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A two-volume set with color illustrations from paintings by Francis Jaques, photographs, maps, and other drawings.

NATURAL HISTORY OF THE BIRDS OF EASTERN AND CENTRAL NORTH AMERICA
By Edward H. Forbush and John B. May *$5.95, postage 16¢*
The life history and a complete, accurate description of every bird to be found east of the Dakotas, Nebraska, and Kansas; it includes Florida to the south, eastern Canada to the north.

BIRDS OF THE PACIFIC COAST
By Willard A. Eliot *$5.00, postage 8¢*
Contains 56 color plates and includes a brief account of the distribution and habitat of 118 birds, many of which are found eastward to the Rocky Mountains and beyond.

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Brazilian Culture

- - - - by Fernando de Azuevedo

The Macmillan Co., $12.50
562 pp., 418 illusts.

IN this era of overworked superlatives, the adjective "monumental" is unquestionably employed too loosely and too often. Yet no other word seems suitable to describe this vast compilation of Brazilian culture history. First published in Portuguese, in 1943, as the introductory volume to the 1940 Brazilian census, the study is conceived on a grand scale and executed with admirable scholarship.

The book is divided into three parts: (1) the Factors of Culture—the environmental and human setting; (2) Culture —the Brazilian achievement; (3) The Transmission of Culture—the history of, and current trends in, education in Brazil. Although the author—a noted sociologist and educator—is thoroughly familiar with the accepted and all-inclusive anthropological concept of culture, he prefers to employ the term in its classic, restricted sense as applying to "refinements of intelligence." In essence, therefore, the book is a study of the origin, growth, and change of intellectual values, ideas, arts, and scientific achievement in Brazil. Only incidentally is it concerned with the material aspects of Brazilian economics and technology.

Following the French sociologists, it is the author's contention that the "genius" of a people receives its fullest expression through its educational system. A third of the book is thus devoted to a historical analysis of Brazilian education as a key to an understanding of the Brazilian "collective character."

Although certain portions of the study seem thin, the author evidences a keen sense of history as well as a tolerant awareness of the multiplicity of factors operative in cultural evolution. All things considered, the book should prove an indispensable addition to any library dealing with the peoples and cultures of Latin America, and it is likely to remain one of the most significant syntheses in the field of Brazilian culture history for many years to come. The illustrations are fascinating for their number and variety, and the index is excellent.

HARRY TSCHOPIK, JR.

The Coming of the Maori

- - - - - - - - - by Sir Peter Buck (Te Rangi Hiroa)

Whitcombe and Tombs, Christchurch, New Zealand, 30/, 542 pp., 24 plates

IN this massive book Sir Peter Buck brings to a climax a lifetime of research, which began in a loving exploration of the culture of his mother's people and extended into many other Polynesian cultures. Sir Peter's work has always been distinguished by the liveliness and humanity which he was able to bring to the details of basket making or mat making, fishing or housebuilding. The material aspects are traced with the greatest accuracy and detail, but they are always accompanied by comment on their meaning in the lives of those who weave and fish and build. This interest in material culture has been paralleled by a deep appreciation of the poetry and mythology of the Polynesians. Taken together, the details of technology and the romance of long voyages, the final settlement and faithful preservation of the records make an impressive work, combining scholarship, field work, historical passion, and sensitive insights into one of the most fascinating groups of people of which we have any knowledge—the Maori of New Zealand.

MARGARET MEAD

Out of My Later Years

- - - - - - - - by Albert Einstein

Philosophical Library, $4.75
290 pp.

ALTHOUGH the pieces that make up this book were written at various times and for various occasions, they have an unexpected unity and cohesion which the range of subject matter would not at first suggest. Many of them are less than a page long, few are more than five or six; they cover personal, scientific, social, political, and biographical matters, and the final section deals with a subject close to Einstein's heart —the Jews. Yet, from this apparently formless assemblage of exhortation, analysis, and comment, there emerges the unifying impression of a human portrait —a self-portrait. For out of the reading of Einstein's reactions to the world of science and to the affairs of men, the reader builds up a picture of Einstein himself that shines forth and grows in luminosity as one continues to read.

Here is a man who writes in all simplicity and with utter sincerity. Since he writes what he feels deeply, what he says is an important part of his spirit. It is a great personality that takes form, one that is deeply concerned with the welfare of mankind and is ready to stand staunchly for the truth as he sees it. A world organization in the form of a supranational state is his answer to the fears and insecurity of the world today.

Einstein's deep faith in tolerance expresses itself again and again in pleas for an acceptance of human differences. Let our children grow up free to express their creative urges most fully, and let us cheerfully and willingly permit nations and groups to develop in their own way.

To those who think of Einstein as an austere and remote mathematician, this book will reveal a warmer, more human person. Here is a wise, gentle, firm man who has thought hard about the human predicament and has much sage advice to give.

HARRY L. SHAPIRO

Yankee's Wander World

Circling the Globe in the Brigantine Yankee

- - - - by Irving and Electa Johnson

W. W. Norton and Company, $5.00.
277 pp., 21 full-color photographs,
58 black-and-white.

TO circle our globe by plane is costly and not very educational. The Johnsons have a better method; they make it possible for their fortunate companions to visit places inaccessible by plane or steamer. These sea-going educators have a ship both beautiful and practical; the crew learns as it goes. What experience

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they gain in 18 months! What strange places and peoples they visit!

Commander Johnson devotes one chapter to this new *Yankee*, a 96-foot brigantine with auxiliary Diesel engines, and 7,775 square feet of canvas. His wife contributes many of the other chapters about their fourth cruise around the world. Merely to pick a congenial crew required rare insight. The first mate must be a competent officer; a doctor and a good cook were essential. In addition there were about ten young men of varied tastes and skills, age around 20 preferred, and four young women not much older. The Johnsons' sons have been seafarers since babyhood.

The *Yankee* set out from Gloucester early in November, 1947, and a very brief sampling of her stopping places includes Haiti, the Galápagos, Easter Island, Pitcairn, the Tuamotus, Tin Can Island, the New Hebrides, New Guinea, Bali, Keeling Cocos, Zanzibar, St. Helena, and Devil's Island. From the coasts of South America, Asia, and Africa, trips were made into the interior. Old friends were encountered in odd places, many new friendships formed.

At Pitcairn the Johnsons are loved and admired. The Governor of St. Helena proved to be an old friend from the New Hebrides. Commander Johnson's war service aided greatly; he knows the places best suited for study. Through days fair or foul, and some serious storms, the *Yankee* sailed on with its crew of enthusiasts. Knowing the Johnsons will show you why. This admirable book, beautifully illustrated, cannot be too highly commended.

JAMES P. CHAPIN

FISHPONDS AND AQUARIUMS

- - - - - - - - - - by Ian Harman

Sidgwick and Jackson, Ltd.,
44 Museum St., London, England
128 pp., 33 illusts., 6/

THE author of this small book writes well and apparently has had a good deal of firsthand experience with fishponds and home aquaria for goldfish and other inhabitants of temperate water. He also possesses the ability to organize his material and present it in logical sequence. But no man should suppose that he knows nearly everything about any field of endeavor, and although Mr. Harman undoubtedly would be the first to agree with this dictum, his book unfortunately seems to indicate this kind of overconfidence—or else a lack of appreciation of the host of errors that inevitably creep into the best of factual manuscripts.

His book is marred by entirely too many small misstatements of fact and orthographic errors—mistakes that could have been eliminated had any wide-awake biologist checked the work. Why do so many popular books show such disregard for the virtue of accuracy? The final responsibility surely lies as much with the publisher as with the author.

With most of the practices and techniques outlined here one would have no quarrel. A few, however, are quite contrary to this reviewer's experience: charcoal has little, if any, effect on the gas content of water and therefore can serve little purpose in a pool or aquarium; breaking the ice over a garden pool is a dangerous practice and hardly ever necessary to avoid smothering the fish; feeding as often as twice a day almost inevitably leads to overfeeding with all its concomitant evils; plants do not oxygenate the water in small pools or aquaria to any appreciable extent and are thus not essential for aeration.

This is, by and large, a satisfactory but undistinguished addition to the growing literature on fishponds and aquaria.

JAMES W. ATZ

A BIRD PHOTOGRAPHER IN INDIA

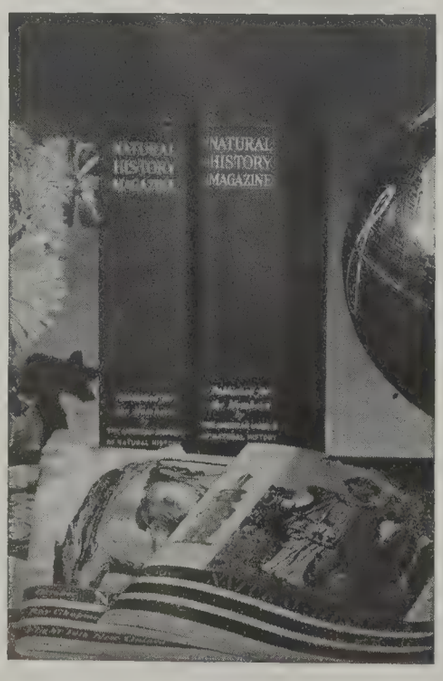
- - - - - - - - by E. H. N. Lowther

Oxford University Press, $5.50
162 pp., 79 plates

FOR 34 years Mr. Lowther has been photographing and taking notes on India's rich and varied bird life. From time to time some of the results were published in the *Journal of the Bombay Natural History Society*, but this serial publication is not readily available, and they are republished here, revised and in greatly augmented form. Half of the illustrations are new.

This book is not just another of those beautiful albums of beautiful bird portraits presenting mostly common species. It has much more merit. In addition to the photographs, of which there are 151 depicting 114 species, the text gives much valuable information on nests, eggs, courtship, food and feeding, and other behavior. Many of the birds at their nests had never been photographed or shown before. All the pictures are valuable, and many of them are striking. The reader may not realize that all this was obtained the hard way. In the region covered (parts of Bengal, Bihar, and the United Provinces) and at the season these pictures and observations were made, the temperature reaches 140 degrees F. The conditions in a cramped and stuffy blind must have been appalling.

This reviewer has but one regret—that in a book of definite value such as this one, scientific names are used but once. This, however, detracts in no sense from



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the popular appeal of the book which, as the jacket claims—for once too modestly, it seems—"is possibly the best collection of Indian bird photographs so far assembled in any book."

CHARLES VAURIE

PLANT DISEASE HANDBOOK

- - - - - - - by Cynthia Westcott

D. Van Nostrand Company, $7.50
746 pp., 111 figs.

HERE is the book for which those of us with small home gardens have been waiting! It is a splendid compendium of 1500 diseases of 1000 common native and introduced trees, shrubs, vines, grasses, garden flowers, and vegetables grown in home gardens, orchards, parks, and parkways anywhere in the United States. Each disease is described, and control measures are discussed. There are elaborate indices of the diseases and their causal organisms; the host-plants are listed with cross references to all the diseases known to attack each plant, and so are the garden chemicals and commercial products used in the treatment of plant diseases. There is even a very gratifyingly up-to-date classification of the pathogens. In the section in which all the diseases known to attack a given host are listed, the distribution of the disease over the country is indicated by the names of the states in which it has been found or by such terms as "general," "widespread," "occasional," etc.

In order to keep the book small enough and sufficiently reasonable in price for the ordinary garden, orchard, or greenhouse owner, the diseases of field crops (such as wheat, rye, oats, barley, rice, and cotton) have been omitted, but corn and the various vegetables likely to be found in small gardens are included. There are 111 excellent photographs and drawings to illustrate the well-written text. The typography and format are excellent for easy readability and quick reference. A selected bibliography of 135 of the most important books, pamphlets, and articles on the subject is included, and the text is filled with suggestions as to where the reader may obtain more information.

This is by far the best book this reviewer has yet seen for the quick detection of diseases caused by bacteria, fungi, viruses, nematodes, and nutrient deficiencies, and their control.

H. N. MOLDENKE

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POPOL VUH The Sacred Book of the Ancient Quiché Maya

English version by Delia Goetz and Sylvanus G. Morley from the Spanish translation by Adrián Recinos

University of Oklahoma Press
Norman, Okla., $3.75, 267 pp.

THE *Popol Vuh* is one of the best of the written documents to have come down to us from pre-Columbian America. It is the sacred book of the Quiché Maya, a large and important branch of the Maya who lived in the highlands of Guatemala but who shared in the unsurpassed civilizational achievements of the lowland groups. Concerning the mythology and traditional history of the Quiché (the creation of the earth and of man, the history of the gods and of the rulers of the Quiché nation), it is a completely native chronicle expressing with apparent fidelity the mode of thought of this advanced American Indian people.

Although the *Popol Vuh* has been widely known for many years through various published editions in Spanish, French, and German, this is, surprisingly enough, the first complete edition in English. Translated from the recent Spanish language edition prepared by the Guatemalan scholar Adrián Recinos, it is most adequately documented with footnotes and with an excellent introduction concerning primarily the history of the document from the time when it was first written down in the Quiché language, but in Latin script, at about the middle of the sixteenth century.

This fine English edition of the *Popol Vuh* should be welcomed by all those interested in the history and philosophy of the American Indian civilizations who have been obliged to wait for an English translation.

GORDON F. EKHOLM

EARLY MAN IN THE NEW WORLD

- - - - - - by Kenneth Macgowan

The Macmillan Company, $5.00
260 pp.

THE history of man and culture in the New World falls into two conventional halves—the earlier Indian phase and the post-Columbian European phase. The reconstruction of the prehistory of America has been a long, arduous, and often exciting adventure. And no part of that enterprise has been more controversial than the problem of dating the first settlement of man in the New World, the origin of pre-Columbian populations, and the existence of cultural influences from the Old World. Opinions on these subjects have undergone radical revision periodically. We are now, as a result of a long series of recent discoveries, in such a season of re-evaluation. With the bars down, speculation has tended to run riot, and some of the fanciful ideas generated by this new freedom can only be taken as by-products of a silly season.

Fortunately, Mr. Macgowan has written in *Early Man in the New World* an excellent introduction to the whole subject, assembling most of the significant evidence, presenting the various and often contradictory deductions, and maintaining, on the whole, a well-balanced attitude toward the competing claims.

In general, Mr. Macgowan's position on many controversial points seems to be a little left of center. He accepts Hooton's and Gladwin's hypothesis that an Australoid or Melanesoid strain antedated the more classic Mongoloid Indian in America. He is significantly open-minded to evidence suggesting trans-Pacific influences on native culture; and, although guarded on dating these early migrations, he is not hostile to the opinions that would place these events further back than the end of the last glaciation.

HARRY L. SHAPIRO

INTRODUCING THE INSECT

- - - - - - - - - by F. A. Urquhart

Henry Holt and Company, $5.00
287 pp., 160 figs., 4 color plates

BECAUSE of the enormous number of different kinds of insects, anyone who attempts to introduce them to the general public can do so only in a sketchy manner. He must select those that are most often seen by the public or that have an unusual appeal because of unusual habits. It is always difficult to select the most suitable examples because different kinds of insects are found in different parts of the country.

Dr. Urquhart has selected types that are very widely distributed in North America, and many of these occur also in Europe and other parts of the world. He has prepared simple, illustrated keys to the orders and to the families of the larger orders, such as the bugs, beetles, bees and wasps, butterflies and moths, and the true flies. Because of lack of space, a few of the less important orders and many families are necessarily omitted. The chapter on making a collection from the beginning to the completion of preparation for scientific study or exhibition will be found most helpful, while the chapter on anatomy and life history

Continued on page 334

▲ A BATTERED SURVIVOR of five centuries of history: the "Tree of the Sorrowful Night." Under this tree, in 1520, Cortes mourned the most crushing defeat sustained by the Spanish in the New World

"Tree o

IN a crowded suburb of Mexico City, in the thick of the clangor and uproar of a great metropolis, stands a gnarled, broken old monster of a tree that gives every evidence of having as many lives as a nimble-witted cat. More lives, in fact; for who ever heard of a cat living upward of 500 years? This battered veteran of the centuries is intimately associated with the history of the Spanish conquest of Mexico, and it bears the melancholy title of "Tree of the Sorrowful Night."

The years have dealt harshly with the tree. Its crown is gone, its branches are splintered, its interior is as hollow as a smokestack—so hollow, in fact, that another tree grows within the main trunk. Yet this gutted giant clings grimly to life, putting forth new leaves and greeting each succeeding spring like an inspired pillar of faith.

The legend that gives the tree its doleful nickname is one of the most colorful in Mexican history. Hernando Cortes paused under the tree during his withdrawal from Mexico City in 1520 and wept for the blow fate had dealt him. Half of his army had been lost in the battle. Gone were all the guns and most of the treasure. Cortes, who had labored for hours to keep the retreat from turning into a rout, sat under the great cypress weeping for the dead and for the loss of Mexico City.

Cortes' Mexican campaign had been a disastrous one. Although having forced themselves into the center of the city, Cortes and his army were unable to gain control of an increasingly hostile populace and decided to retreat to safer ground. Mexico City stood on an island in the center of a lake. It was reached from the mainland by an elaborate system of causeways and was protected by warriors on foot and in innumerable canoes. The solidly constructed causeways were wide enough for several horsemen to ride

...e Sorrowful Night"

An ancient patriarch that saw a conqueror weep and lived to symbolize his sadness

By Philip Ferry

abreast. With so many hazards surrounding their escape, the Spaniards were like rats fighting their way out of a trap.

The Spaniards planned to evacuate their position under cover of darkness, and at midnight on June 30, 1520, they began the soul-breaking march from Mexico City—"the scene of so much suffering and such indomitable courage," as Prescott phrased it. Each soldier carried as much gold as he could; Cortes and his captains took the lead, followed by the squadrons carrying treasure and baggage. As the Spaniards reached an open breach in the causeway and were in the act of laying a portable bridge across the gap, they were discovered by the sentinels.

From Alfonso Teja Zabre's
Guide to the History of Mexico, Mexico, 1935

"Tree of Tule"—the oldest, largest, and most celebrated tree in Mexico. Some ontezuma cypresses are said to be at least 3000 years old and are obviously the mnants of a great tropical forest that once covered the valley of Mexico

dak Mexicana Ltd.

Photo by Cia Mexicana de Aviacion

▲ TYPICAL MEXICAN STREET SCENE. In many parts of sunny Mexico the Montezuma cypress is sought as a shade tree

The alarm was sounded, the city was roused, and thousands of vengeful Aztecs came swarming over lake and causeway.

The Spaniards were set upon from all sides. The battle raged the length of the causeway, the breach being soon filled with equipment and the bodies of men and horses. The fighting continued throughout the night, the hard-pressed Spaniards battling desperately like cornered animals. With dawn, the survivors managed to fight their way to the mainland. As they streamed by and rallied on a slight rise to the west of the city, the exhausted commander dismounted and gazed sorrowfully on the broken remnants of his army.

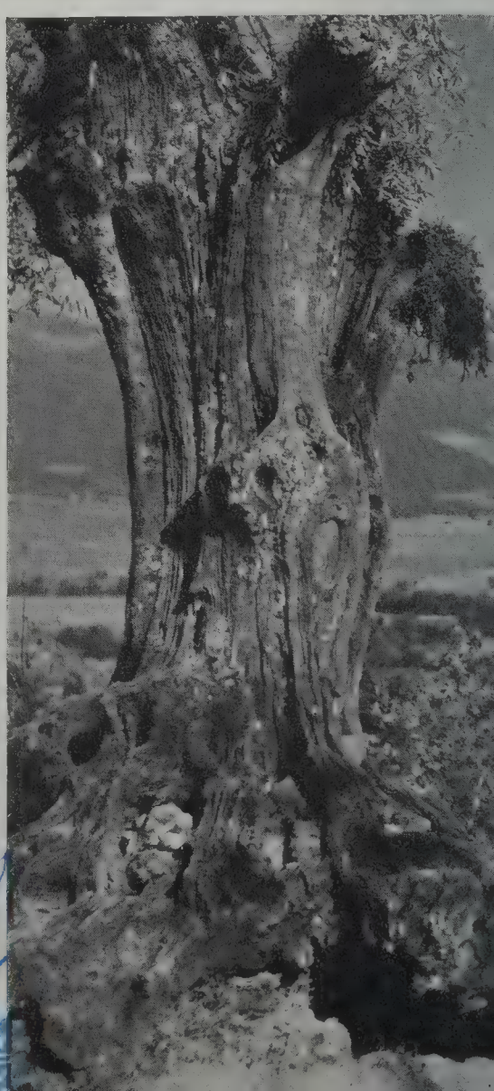
What a sad spectacle they presented! Gone was the treasure and hundreds of their comrades. The exhausted cavalry, most of them afoot, dragged themselves wearily along, their shining armor battered, their elaborate raiment and crests dripping with water, their proud banners gone. Cortes looked at his thinned and disordered ranks. Though accustomed to control his emotions, the sight was too much for him. Covering his face with his hands, he gave way to tears.

It was the worst defeat sustained by Spanish arms in the New World. That night of disaster, which took half of Cortes' army, was branded "La Noche Triste" (The Sad, or Melancholy, Night), while the tree that was the scene of his sorrow became similarly known as El Arbol (The Tree) de la Noche Triste.

This tree under which Cortes bemoaned his unhappy fate (although a year later he was to succeed in reducing the city) was a giant Ahuehuete, as the Mexicans call it, or Montezuma Cypress as it is also known (*Taxodium mucronatum*, the *Cupressus disticha* of Linnaeus). It belongs to a family of conifers and is related to the deciduous American bald cypress in the United States. Appropriately enough, the tree has always been a symbol of mourning and sadness. In ancient times its branches were used at funerals and to adorn tombs.

Because of the tendency of the branches to spread horizontally, the tree has always been sought for its shade. In the even climate of the Mexican highlands the species attains great age, with a tremendous over-all spread of branches and enormous size, as is evidenced by some of the specimens in the forest of Chapultepec Park in Mexico City. Perhaps 200 of the old ahuehuetes remain in the park. Some are declared to be at least 3000 years old and are obviously the remnants of a magnificent tropical forest that once covered the great valley of Mexico.

Although the trunks of some of the trees are enormous—the Montezuma Tree, largest in the park, has a circumference of 45 feet—decay has eaten into the heart of many of the patriarchs. In this respect, the ahuehuete seems to lack the invulnerability of California's sequoias, which are capable of living not only



centuries but millenniums without decay.

The Tree of the Sorrowful Night is one of the largest ahuehuetes known. I stepped off the circumference of the tree and estimated the girth to be something over 60 feet, which would give it a diameter of around 20 feet—a giant by any standards. Even in Cortes' day it was a wide-branched centenarian offering welcome shade to a good-sized detachment.

Cortes seems to have had a special fondness for these giant cypresses, and there are three associated with his name. During the early days of his advance from the Atlantic coast to the valley of Mexico, he stopped at the Indian village of Tlatlauquitepec and remained several days to rest and refresh his troops. Modern Indians have long pointed out the venerable *Arbol Grande* to whose branches the Conqueror hitched his horse.

The third of the giant cypresses connected at least in legend with Cortes' Mexican campaigns is today the oldest, largest, and most celebrated tree in Mexico. It is the great Tree of Tule, or Arbol del Tule, as the Mexicans call it, a giant cypress standing in the churchyard of Santa Maria del Tule (Holy Mary of the Bulrushes) about six miles from the city of Oaxaca, in southern Mexico.*

Cortes has been dead these 400 years, having flashed through Aztec history like a thunderbolt across a summer sky. The great ahuehuetes that marked his advance in the New World still flourish. Coursing through the fibers of these indomitable patriarchs seems to be some of the iron that flowed through the veins of Cortes. Where the Spaniard conquered a people, these trees have prevailed over time—a vastly greater achievement.

The Tree of the Sorrowful Night has shown in its resistance to time the same hardihood and unyielding stubbornness that Cortes displayed in the face of repeated disaster. Fanatical Indians attempted to burn it three-quarters of a century ago. As a result, it is so hollow that one wonders what keeps it upright. Actually, it is a mere shell. Patched and wired like an ancient Model-T Ford, it looks as if it would prove an easy victim to one of the strong winds that sweep across the plain of Mexico. Yet it goes on living, providing welcome shade for the picturesquely costumed peons who seek the shelter of its spreading branches and massive trunk.

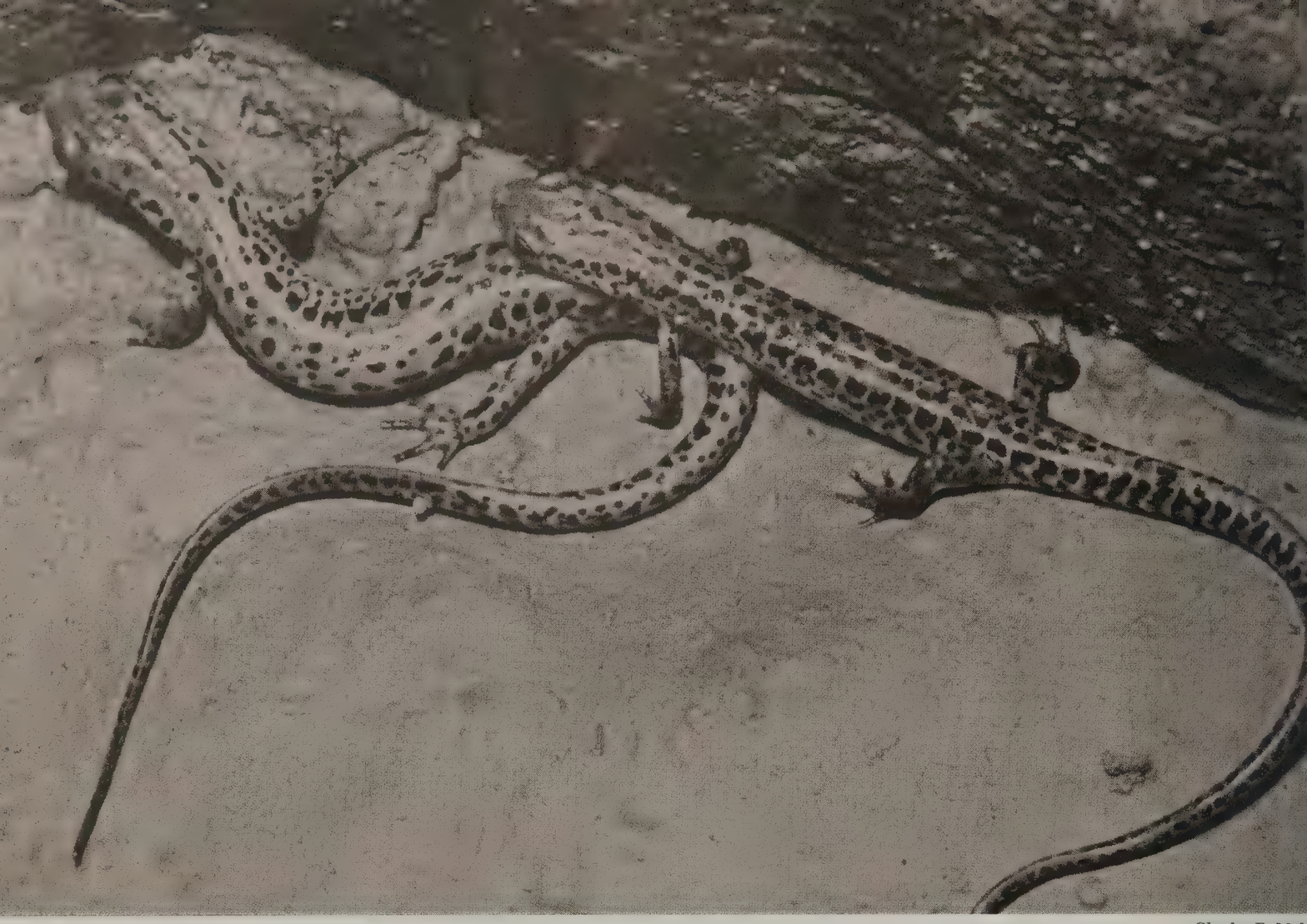
In recent years science has come to its rescue with the latest advances in tree surgery. By removing the dead matter from the interior and plugging many of the worst holes with concrete, by painting the open wounds with a veneer of preservative and by stopping up many of the gapping holes in the lower trunk, it is hoped that the noble old veteran's days will be prolonged.

Today the Tree of the Sorrowful Night forms the central feature of a tiny neighborhood park in Mexico City, and all commercial tours of the city include a visit to the tree. Children crawl over the knobby body, swing on the gnarled protuberances, and run in and out of the gutted interior. Surrounded with all the hubbub of a large city, hemmed in by a few square feet of greensward, and identified incompletely by a sign that now carries only the single word *Arbol*, it looks exactly what it is: a survivor of the past and a memento of a time when the great plain of Mexico echoed to the tread of mailed conquerors.

One cannot say that history retains any particular veneration for the memory of Cortes or special glory for his dubious achievements; but history can have nothing but admiration for a weather-beaten, gutted old patriarch of a tree that goes on living and sending out green leaves like any lusty young seedling. The natives know Cortes only as a legend; they live intimately with this giant cypress that bears its years and fame with a dignity signifying complete disdain for the transient achievements of a man on horseback. In the life span of a great tree, what is one so-called conqueror more or less!

*See "A Methuselah among Trees," by Walter Henricks Hodge, NATURAL HISTORY for May, 1948

LIKE SENTINELS at the gate, these cypresses seem to guard the slumber of the mighty volcano Popocatepetl



Charles E. Mohr

▲ THE TAIL AMOUNTS TO about 60 per cent of the total length of the long-tailed salamander, *Eurycea longicauda.* Most salamanders of this genus perform an elaborate courtship ritual. The male massages the female's chin with the top of his tail, as shown here

LUNGLESS *Salamanders*

For centuries it was not realized that many of our familiar salamanders live without lungs or gills

By ROMEO MANSUETI

THE year 1894 is not famous for extraordinary events, but a small group of zoologists may recall it for the minor sensation caused by a fellow-worker, Professor H. H. Wilder, of Smith College in Northampton, Mass., exploded the bomb by announcing in the staid periodical *Anatomischer Anzeiger* the discovery of *"Lunglose Salamandriden."*

"Lungless salamanders" seemed such a curious phrase that a flurry of comment followed the announcement. Professor Wilder spoke of these four-footed, tailed amphibians as neither possessing gills nor lungs in the adult stage—a most unorthodox situation. Many biologists simply scoffed at the statement. Others wanted to know how their blood could be oxygenated. And amateur naturalists put the question simply: "How can the darn things breathe?"

Influential, erudite Professor Edward Drinker Cope, America's veteran comparative anatomist of that period, stated unequivocally that he had been dissecting salamanders most of his life and had always found lungs in them. Nonetheless, Cope's colleagues found that he was mistaken in the case of the salamanders of the large family Plethodontidae, all of which proved to be lungless.

This important and very surprising fact had not been observed or suspected up to that time, although these animals had been studied by numerous investigators both in America and Europe. True, a German embryologist, Heinrich Rathke, had first noticed the absence of

Charles E. Mohr photo

➤ EGGS OF THE RED-BACKED SALAMANDER, *Plethodon cinereus.* The big dark eyes of the salamander embryos show clearly through the transparent gelatinous cases. The eggs are one-fifth inch in diameter, and after two months of incubation, the young, nearly an inch long, will emerge. These eggs are generally found in crevices in decaying logs, but this grapelike cluster was found suspended from the underside of a flat stone

➤ THE RED-BACKED SALAMANDER, *Plethodon cinereus,* which emerges from these eggs, lives completely away from the water and can withstand a great deal of dryness. It is a small salamander—only about half the size shown here

August Selckmann photo

lungs in the worm salamander, *Batrachoseps attenuatus*, as early as 1833. But it was Professor Wilder who first demonstrated that the lack of lungs was normal and widespread among these curious and colorful creatures. Even today, very few people imagine plethodontid salamanders as freaks of nature.

Elfs and goblins are the acknowledged but mythical inhabitants of the forest, but the plethodontid is the only genuine sprite of the woodland within reach of many naturalists. When discovered by the novice in its natural habitat, its smooth and shiny body, augmented by brilliant hues and striking patterns, gives the illusion of a jewel gleaming in the dull earth or mud. Delicate, as if created by the careful craftsmanship of a glassblower, these miniature amphibians are commonly found in springs, along streams, and even on land. To find them, one must overturn rocks and logs, plunge a hand into ice-cold springs, and suffer other inconveniences. Despite their apparent abundance, few people ever see them, for many are rather secretive and are apt to be clever escape artists.

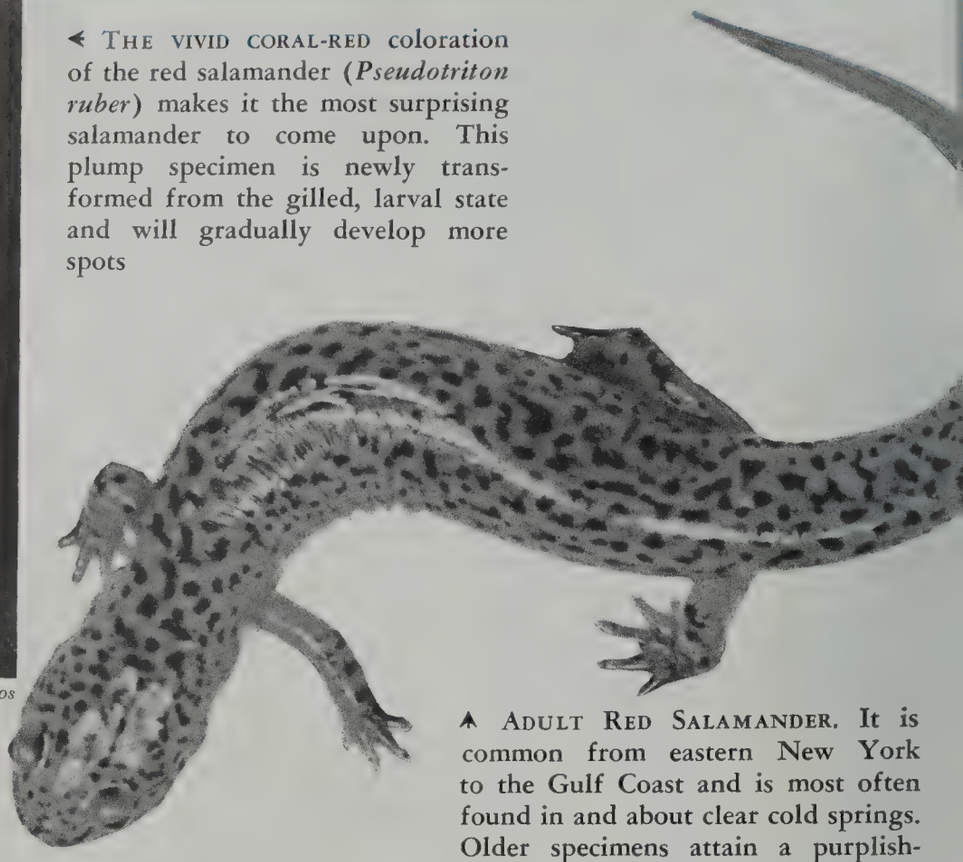
Among the celebrities of this family of salamanders, the common red salamander, *Pseudotriton ruber,* is an excellent example of a brilliantly-colored species commonly found over most of the eastern United States. When uncovered from beneath a rock in a spring, it strikes one as being too startlingly vermilion to be a natural part of the countryside. On the other hand, its bright hues might easily frighten some nature lover who associates venomous qualities with such a gaudy creature. Of course, the red salamander is not poisonous; all plethodontids are perfectly harmless. Contrary to the principle that the coloration of most amphibians matches their surroundings fairly well, the red color of *Pseudotriton* seems to defy explanation on a basis of protection. Rather, these tints are like those of the leaves in autumn—beautiful but without value.

In the same class as the red salamanders, the long-tailed salamander, *Eurycea longicauda,* reigns almost as champion by having a record-length tail. The tail of an adult is about one and a half times the length of the fragile-looking body. But the very rare Alaska worm salamander, *Batrachoseps caudatus,* sports an even more splendid tail, which is almost twice the length of the body of the adult. The long-tailed salamander is yellowish-orange, with a series of black spots along the sides of the body. Adults are found mainly in and beneath old rotting logs and under flat rocks adjacent to streams. It is also a cave dweller. When a flashbeam plays upon it in such surroundings, it looks like some strange and beautiful specter.

Juvenile long-tailed salamanders and their relatives breathe by means of externally visible staghorn or bushy gills, the three branches arising from a common

Charles E. Mohr photos

◀ THE VIVID CORAL-RED coloration of the red salamander (*Pseudotriton ruber*) makes it the most surprising salamander to come upon. This plump specimen is newly transformed from the gilled, larval state and will gradually develop more spots



▲ ADULT RED SALAMANDER. It is common from eastern New York to the Gulf Coast and is most often found in and about clear cold springs. Older specimens attain a purplish-brown color, with numerous irregular spots. Adults average five inches in length

base. These merely lie exposed to water currents. The water bathes the many fine filaments, which are covered by delicate epidermal membranes that contain blood channels, and the exchange of oxygen and carbon-dioxide gas occurs between the blood and the water. Larval salamanders display aquatic adaptations before metamorphosis; but shortly before the pre-adult stage, the gills and fins atrophy and the dull larval hues change as if by magic to vivid colors. It is at this stage that plethodontid salamanders exhibit their peculiar anatomical individualism.

When the external gills disappear, normal "breathing" presumambly stops because of the absence of lungs. Plethodontids continue to "breathe" as adults, nevertheless, but in their own strange way. Even in other families of salamanders, the lungs are now considered to serve chiefly for regulating buoyancy rather than as respiratory organs. The utilization of certain marvelous breathing mechanisms compensates for such a great loss. First of all, plethodontids depend largely upon skin respiration. The blood is aerated through the very thin and constantly moist epidermis. Tiny blood vessels that penetrate to the surface of the skin carry on the vital oxygenation. Secondly, the lining of the mouth is very vascular and also serves as a respiratory organ.

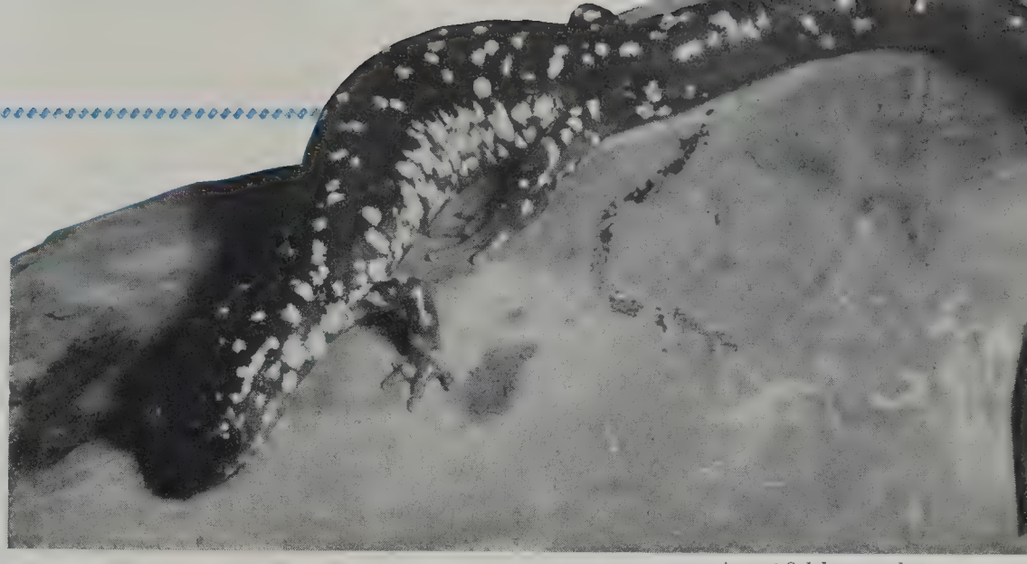
With such specialized structures for "gulping" or "sweating" for air, one might expect the activity of lungless salamanders to be restricted to imperceptible movements. On the contrary, most species are very active in their particular habitat. Some of the dusky salamanders of the genus *Desmognathus* are truly water acrobats when stirred.

Brooks are the "sanitariums" for many lungless salamanders. Swift-running, gushing streams are highly oxygenated, hence a perfect home for a lungless animal. Lungs having a hydrostatic function would obviously be of no particular advantage in swift currents, so their loss in that sense is no sacrifice.

All amphibians are cold-blooded, including, of course, the plethodontids, but they do not suffer in their cold aquatic environment. Bitter-cold water in winter and anything short of freezing cannot lull the salamanders into hibernation. Many are active all winter.

A home on dry land might seem to be most uncomfortable for a lungless salamander, but many of them live in such situations. Landlubbers, such as the slimy salamander, *Plethodon glutinosus,* and the red-backed salamander, *Plethodon cinereus,* surely possess a special mechanism for resisting desiccation. Such species usually do not go near water. They lay their eggs in little cavities in logs or humus, and the parents often brood them. Possibly the female remains with the young after they hatch, not to protect them from enemies but to prevent them from drying by keeping her moist body in contact with theirs. Salamanders, by and large, are not better endowed than some fishes in their ability to learn or remember, and few of the behavior patterns found in higher animals can be ascribed to them.

As in all animal groups, certain "personalities" stand out more than others. The purple salamander, *Gyrinophilus porphyriticus,* might be called Public Enemy No. 1 of the plethodontid world, because it is



August Selckmann photo

THE SLIMY SALAMANDER, *Plethodon tinosus,* is noted for its use of a sticky k-white slime to escape from its en- es. The substance is not poisonous to n, but it leaves a mucous deposit on 's hands that is difficult to remove when dries

August Selckmann photo

➤ DESPITE ITS NAME, the Purple Salamander (*Gyrinophilus porphyriticus*), is a salmon-colored creature. It is the cannibal of the salamander world, since it eats closely related salamanders and even its brothers and sisters. Its mating season is in the autumn, contrary to the schedule of most other wild animals

➤ THE TEXAS BLIND SALAMANDER (*Typhlomolge rathbuni*) never "grows up." That is, it never outgrows its larval habit of breathing through external gills. It is a rare inhabitant of underground streams in the Edwards Plateau, Texas. It has pin-point eyes beneath the skin

Charles E. Mohr photo

a confirmed cannibal. It is a suave, salmon-colored fellow that lives in very cold springs. It has been known to devour such close cousins as the four-toed, two-lined, and dusky salamanders, and it may even eat unlucky brothers and sisters. It also feeds upon aquatic insects, crustaceans, and even frogs—yet its total length is only six and a half inches.

It is in the autumn that the young male purple salamander's fancy lightly turns to young females. After an elaborate courtship involving a wrestling dance, eggs are laid in flat masses beneath stones in flowing water. Perhaps the eggs are brooded, but this is not definitely known.

The slimy salamander's chief claim to fame is its ability to exude a viscous, milk-white slime when it is seized by an enemy. It is a shiny creature, looking much like a licorice stick sprinkled with sugar. Its slime is harmless to man, but it is not soluble in water and is difficult to wash off when it dries. Perhaps it affords protection from other animals but not usually from a determined person.

Houdini never left an arm or leg behind after one of his spectacular escapades, but the slimy salamander will frequently part with an entire tail in order to remain free. If you grasp the creature by the tail, it will voluntarily twist it off. But you need not feel sorry, for the salamander will grow another in its place. A slimy's tail is used as a brace against a rock or burrow in the event of an attack.

If prizes were given for speed in disarticulating the body from the tail, the four-toed salamander, *Hemidactylium scutatum,* would easily take first place, because it has a curious constriction at the base of its tail. Four toes on each foot, rather than four on the front

and five on the hind feet, set this salamander apart from other members of the family. The courtship proceedings in autumn consists of a series of what we might call "osculating" antics, during which the male applies his lips, cheeks, or the side of his body to the snout of the female. Courtship culminates when the female follows the male, keeping her chin closely pressed against the base of his tail. The male, especially when he is not moving forward, undulates the base of his tail from side to side. He deposits a sperm capsule, which is taken up by the cloacal lips of the female, and the eggs are subsequently fertilized. In spring the female retires to a nest or cavity in sphagnum moss at the water's edge. She occupies these little openings in the moss and rests *upside down,* grasping rootlets and bits of moss with her feet while slowly forcing the eggs out, one at a time. The process has been described by Dr. Sherman C. Bishop, America's famed salamander specialist. Laying eggs upside down is a common procedure among a large number of plethodontids. In fact, anyone who studies them carefully will note many curious modes of reproduction, feeding, and other habits.

The strangest plethodontid is a ghostlike creature dwelling in the caves and underground passages of the limestone region in the Ozarks of Missouri. This blind salamander, *Typhlotriton spelaeus,* has functional eyes as a larva, during which time it lives chiefly near the mouths of caves. But during metamorphosis it penetrates deeply into caves, and soon the lids draw together, fuse in part, and the light-sensitive rods and cones of the retina disappear. Scientists have found, however, that if the young metamorphosed blind salamander is subjected to the stimulus of light, it will develop functional eyes. Two other grotesque-looking blind salamanders are known, one from Texas, the other from Georgia, and they live in the netherland of wells and subterranean streams.

The lungless salamanders must really be considered more American than the American Indian, in the sense that the salamanders arrived first. Only one major family, the Salamandridae, is supposed to have existed when a connection between Europe and America was available in the early Eocene, 50 or 60 million years ago. When the continents separated, the American Salamandridae took to the mountain brooks of the Appalachians and took on plethodontid characteristics. The plethodontids are a much younger group, therefore—speaking in terms of millions of years—than some of the other families. They later became terrestrial and migrated to western North America and South America—all in a period of several million years. Even today the southern Appalachians have the largest concentration of lungless salamanders.

There is one puzzling species, the Mount Lyell salamander—a salamander with a European cousin. This salamander, *Hydromantes platycephalus,* made its debut into the scientific world by wandering into a mousetrap at an elevation of 10,800 feet in the Yosemite National Park. Since then, this Alpine salamander has attracted a great deal of attention because we find it so far removed from its nearest relative. A single related species is found in Sardinia, the French Alps, and part of northern Italy. How the two species can have become so widely separated, with the Atlantic Ocean in between, has been hard to explain. Dr. Emmett Reid Dunn, the brilliant student of lungless salamanders, has considered the *Hydromantes* a relict genus. He reasons that the genus must have traveled from America to Europe by way of Greenland and Iceland, since no more southerly route is known to have existed during the period under consideration. Another possible explanation is that these salamanders crossed from North America to Asia by means of the Bering Strait connection, which is known to have existed much more recently than any

Continued on page 332

Early "

Some of t

IN the fall of 1924, a workman Mr. M. de Bruyn, blasting ou rock in a limestone quarry abou six miles from the little village o Taungs in South Africa, discovered a remarkable skull. He took it to b a fossil Bushman skull and showed it to Mr. Spiers, the manager. Mr Spiers sent it to Prof. Raymond A Dart, of the Witwatersrand Uni versity.

This Taungs Skull, as it came t be called, was one of the fines fossil human or prehuman skull ever discovered. It was uncrushed and was beautifully preserved on one side. All the deciduous teeth and the permanent first molars upper and lower, were in place and their crowns were little worn The lower jaw was actually in place, with only the rear lower par missing. Furthermore, the skul showed on one side most of the cast of the brain.

Within a few weeks, Dr. Dar had written his preliminary repor on this find, in which he made the exciting statement that this skul was from "an extinct race of apes intermediate between anthropoids and man." He had secured the nearest thing to the popular con ception of a "missing link." "Unlike *Pithecanthropus,*" he stated, "it does not represent an ape-like man, a caricature of precocious hominid failure, but a creature well ad vanced beyond modern anthropoids in just those characters . . . which are to be anticipated in an extinct link between man and his simian ancestor."

As soon as the discovery had been announced, Dr. Robert Broom went to Johannesburg to see it. Dr. Broom, then in his fifty-eighth year

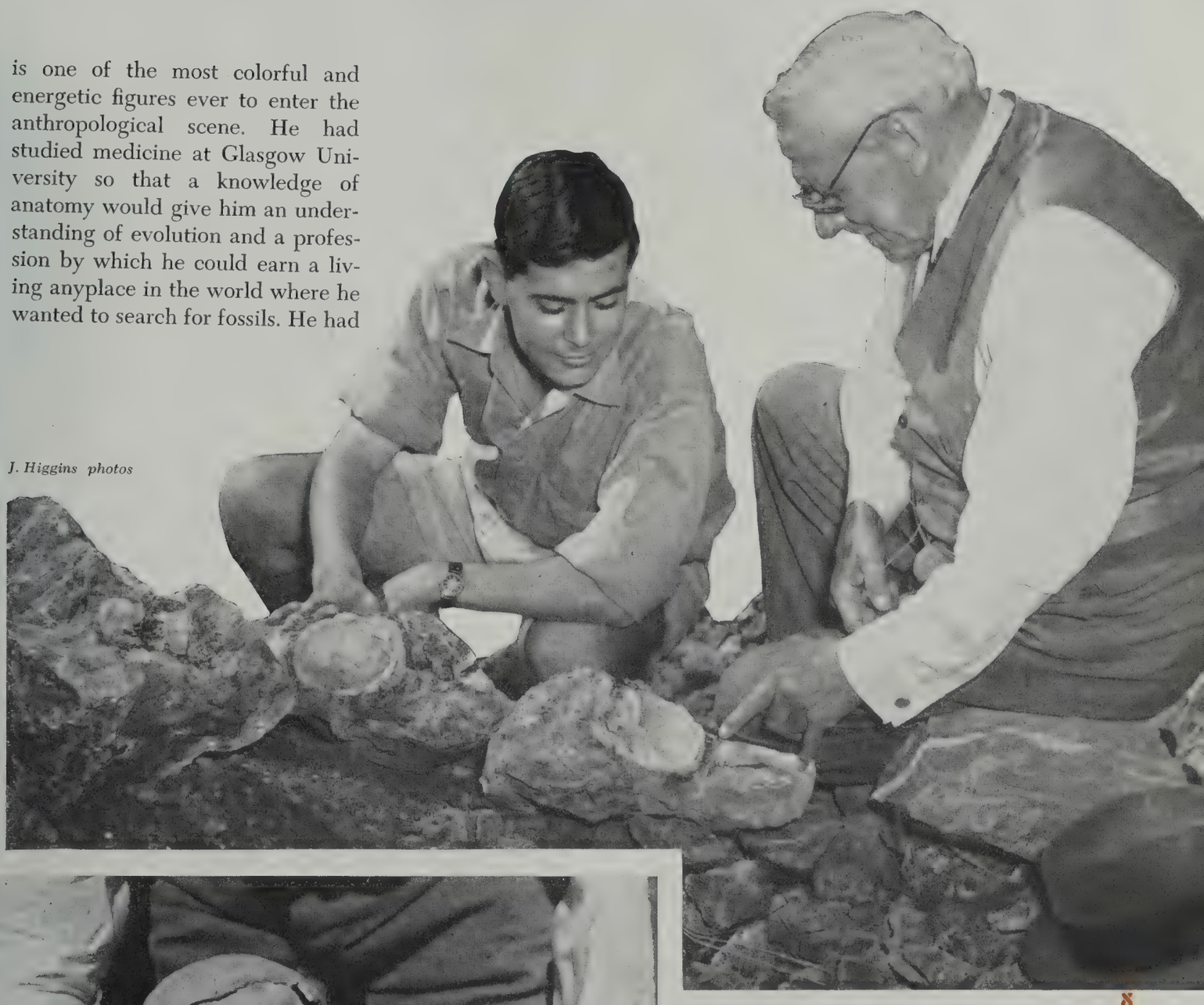
sing Links" from Africa

c discoveries clarifying man's earliest ancestry have come from the Transvaal

By Dan Lincoln Thrapp

is one of the most colorful and energetic figures ever to enter the anthropological scene. He had studied medicine at Glasgow University so that a knowledge of anatomy would give him an understanding of evolution and a profession by which he could earn a living anyplace in the world where he wanted to search for fossils. He had

J. Higgins photos



▲ The Sterkfontein Skull found by Dr. Robert Broom in April, 1947, was nearly perfect. The skull was broken across the brain cavity and was lined with a layer of lime crystals

◀ The Face. Here most of the stone has been removed and the pieces of the face have been temporarily put together to show the facial contours of the Sterkfontein Skull

carried through his plan, and a quarter of a century of determination, diligence, and deduction, with the help of a little dynamite, had brought him wide recognition in the science of paleontology.

Dr. Broom stoutly supported Dr. Dart's conclusions as to the profound significance of this skull. It represented, he was convinced, a creature far from an ape and very close to the main stem of the human family tree.

Even though this skull conformed perfectly to the expectations of Darwin, Huxley, Haeckel, and their numerous successors, some scientists were slow to accept Dart's conclusions. The eminent physical anthropologist Aleš Hrdlička was on the fence. However, Dart's and Broom's conclusions were sooner or later welcomed by Prof. G. Elliot Smith and Prof. W. J. Sollas of Oxford, and by Drs. James H. McGregor and William K. Gregory of Columbia University and the American Museum.

Shortly after the discovery was announced, four of the leading anthropologists of Britain were asked by the British scientific publication *Nature* to express their views. They were Sir Arthur Keith, Prof. G. Elliot Smith, Sir Arthur Smith Woodward, and Dr. W. L. H. Duckworth, all world renowned.

Australopithecus africanus, as Dr. Dart named the skull, portrayed to Keith a blend of immature chimpanzee and gorilla characteristics, but he added, "Even if it be admitted that *Australopithecus* is an anthropoid ape, it is a very remarkable one. It is a true long-headed anthropoid—the first so far known."

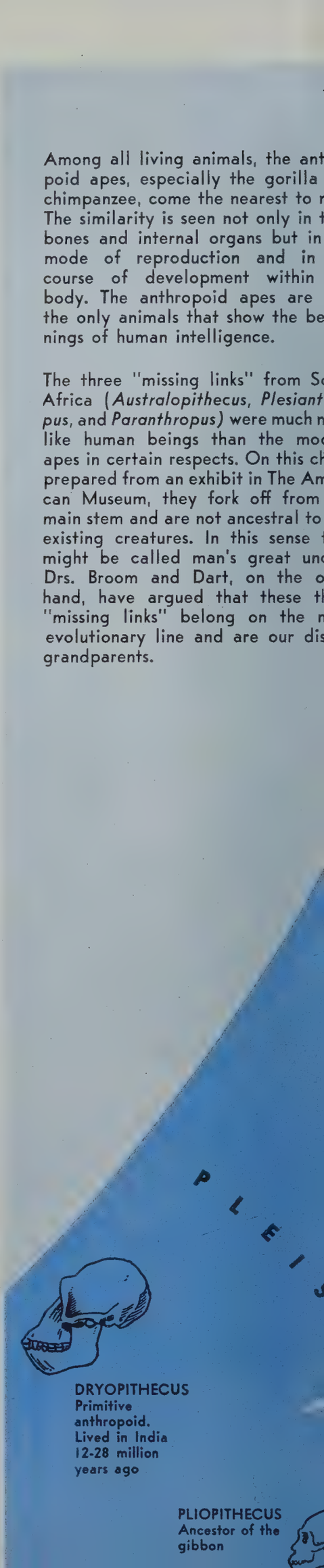
Elliot Smith thought Dart was "justified in creating a new species or even a new genus for his interesting fossil," but he thought that "many of the features cited by Prof. Dart as evidence of human affinities . . . are not unknown in the young of the giant anthropoids." Smith Woodward said, "So far as can be judged from the photograph I see nothing . . . definitely nearer to the human condition than the corresponding parts of the skull of a modern young chimpanzee." Duckworth admitted that the specimen "possesses exceptional interest and importance." He thought that some of the supposed manlike characteristics were due to "the youthfulness of the specimen," but added that "if the good points can be justified, then these characters of youth will not gravely affect the final decision." On the basis of evidence then at hand, these statements do not even now sound unreasonable for the most part.

But Drs. Broom and Dart set about together to change the views of the faraway scientific authorities whose word, they felt, might have a crucial effect on world-wide opinion. Dr. Broom sent a section of the Taungs skull to Oxford's Prof. W. J. Sollas, who was on record as agreeing with Elliot Smith. Sollas immediately replied that the section "seems to me to throw quite another light on the matter." He said he had just written to *Nature* to show how widely Taungs differed from a chimpanzee skull. And he was preparing another paper to show how nearly it resembled man.

Elliot Smith soon came to agree with Sollas. American anthropologist Dr. Aleš Hrdlička agreed that *Australopithecus* was a "missing link" but qualified this by saying that it was one of many still "missing links in the realm of primate ancestry." Later, Dr. W. K. Gregory of the American Museum studied the teeth and found 20 characteristics in which they resembled or were transitional to man, none in which they clearly resembled the chimpanzee, and only three in which they were nearer to the gorilla or to the gorilla and chimpanzee. Other anthropologists gradually became convinced, and after the Sterkfontein and Kromdraai finds, which will be discussed later, even Sir Arthur Keith conceded, in 1944, that "no doubt they are much more human than I had originally supposed." Oxford University's famed anatomist Prof. W. E. Le Gros Clark has quite recently swung his full weight behind Dr. Broom in the conviction that the Australopithecinae, the sub-family of extinct forms defined by William K.

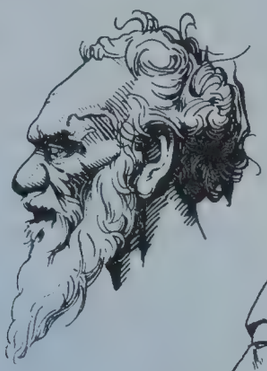
Among all living animals, the ant
poid apes, especially the gorilla
chimpanzee, come the nearest to r
The similarity is seen not only in t
bones and internal organs but in
mode of reproduction and in
course of development within
body. The anthropoid apes are
the only animals that show the be
nings of human intelligence.

The three "missing links" from So
Africa (*Australopithecus, Plesiant
pus,* and *Paranthropus)* were much n
like human beings than the mod
apes in certain respects. On this ch
prepared from an exhibit in The Am
can Museum, they fork off from
main stem and are not ancestral to
existing creatures. In this sense t
might be called man's great unc
Drs. Broom and Dart, on the o
hand, have argued that these th
"missing links" belong on the m
evolutionary line and are our dis
grandparents.



FAMILY TREE OF MAN

MODERN WHITE

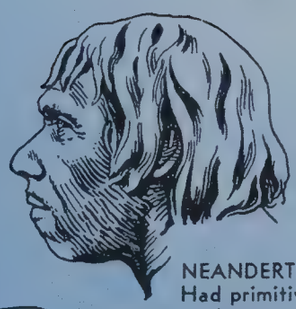


MODERN AUSTRALIAN

AGNON
ent, artistic, and
-looking European
40,000 years ago.

MODERN CHINESE

RECENT

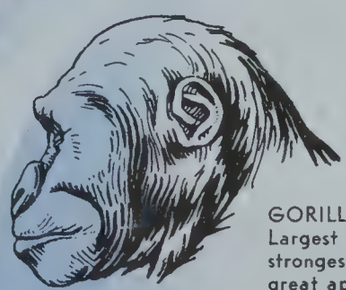


NEANDERTHAL
Had primitive profile; made many tools. Lived for 100,000 years or more before Cro-Magnon

MODERN NEGRO

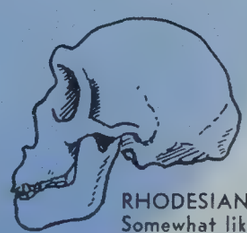
NTHROPUS
Man)
pelike.
500,000

HEIDELBERG MAN
A massive jaw, teeth primitively human. Lived in second interglacial stage of Ice Age.



GORILLA
Largest and strongest of the great apes—Equatorial Africa

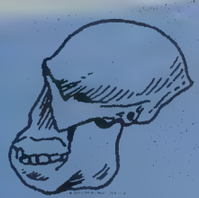
PEKING MAN
A very primitive type but more advanced than Pithecanthropus. Made fire, used tools, probably spoke



RHODESIAN MAN
Somewhat like Neanderthal but more brutish, with massive eyebrow ridges

CHIMPANZEE
Smaller and less ferocious than gorilla

PARANTHROPUS
Had larger brain than other two and a tremendously powerful jaw



PLESIANTHROPUS
Most manlike of the missing links from South Africa

AUSTRALOPITHECUS
A 100-pound creature that stood upright, hunted in groups, and had milk teeth like a Bushman child

ORANGUTAN
Anthropoid ape of Borneo

GIBBON
Smallest of the anthropoid apes

Gregory and Milo Hellman in 1938, were very close to the main stream of human evolution.

The discovery of the Taungs Skull caused Dr. Broom to redouble his diligence as a fossil hunter, and he worked tirelessly to find additional evidence to support and amplify the original claims. But it was not until twelve years later that his devotion was rewarded. On August 17, 1936, at Sterkfontein, near Krügersdorp, a lime quarry foreman, G. W. Barlow, handed him the blasted-out natural brain cast of a missing link and asked, "Is this what you're after?" Dr. Broom replied, "That's what I'm after."

He at once began a meticulous search of the cave from which the brain cast had come. The next day he found additional pieces of the same specimen, and in a few years he had discovered parts of three other skulls, all probably of the same species. This type was different from the Taungs creature but evidently related to it. Dr. Broom continued his search for new types, and within two years he made another sensational find.

Barlow one day handed him a piece of a palate that he had gotten from a fifteen-year-old schoolboy, Gert Terblanche. The boy had found it at Kromdraai, two miles east of Sterkfontein.

"Of course I immediately set out in pursuit of Gert," wrote Dr. Broom. "I went to his home. Gert was in school, another two miles away; but I saw his mother and sister, and his sister took me up to the top of an adjacent hill where the specimen had been broken out of a weathered outcrop of bone breccia. The sister told me that Gert had four beautiful teeth with him at school, and she was sure he had some other nice pieces hidden away somewhere.

"I went off to the school. It was playtime, about 12:30 P.M., when I arrived. I saw the principal and told him what I had come about. Gert was found, and he drew from his trousers pocket four of the most wonderful teeth ever seen in the world's history. Two of these fitted on the palate that I had in my pocket. The other two were teeth of the other side.

"Gert told me that there were some more bits hidden away on the hillside. As the school broke up at 2 o'clock, I suggested to the principal that I would give a lecture to the teachers and the children on how the caves were formed and how animal bones got into them. He was delighted. So I lectured to 4 teachers and about 120 children for over an hour. As it was now almost 2 o'clock, the principal dismissed the classes, and Gert came away with me and took me to the place on the hill where he had carefully hidden away a nice lower jaw. I gathered every fragment." The newest find was different from either the Sterkfontein or the Taungs remains.

Dr. Broom now had three distinct types of apemen, or man-apes —the argument over which they are to be called has not yet ended.

Each of the three new finds, Dr. Broom believed, represented a different genus. The Taungs skull had been named *Australopithecus africanus* Dart. The Sterkfontein creature became *Plesianthropus transvaalensis* (Broom). And the Kromdraai specimen, which had been found by Gert Terblanche, was named *Paranthropus robustus*

J. J. Wesselo photo. Copyright.

◄ DR. BROOM comparing the Sterkfontein brain case with the human (*left*) and the chimpanzee (*right*). Though it is much smaller, he considers it more closely related to the human

Broom, the "*robustus*" referring to its tremendously powerful jaw.

Dr. Broom resumed digging at Sterkfontein after the war and within a few months found parts of several other skulls. He also found the greater part of a pelvis that was almost human and many limb bones of his strange and important little creatures. In all, he probably has pieces from a dozen or more different individuals, and some of the skulls are nearly complete and quite uncrushed. From them, and from the ribs and limb bones, he could tell quite a bit about what sort of animals they represented. Of the three, *Plesianthropus* seemed the most manlike, although *Paranthropus* had the largest brain. His *Paranthropus crassidens* jaw, found quite recently in a new site (Swart Krans) has an incipient chin, and its general appearance is "almost human." Thus, some of the later Australopithecinae may have crossed the invisible and arbitrary border between apes and men.

The face bones of *Plesianthropus*, in certain details approach the human, and the limb bones were so manlike that at first there was some suspicion that modern bones might have been intermixed with the fossils. This was promptly proved impossible. Entire limb bones are as yet extremely rare, but Prof. Straus of Johns Hopkins has made prolonged studies of the distal end of the humerus ascribed to *Paranthropus robustus* and has stated that it falls within the ranges of both apes and men. Therefore, its exact status is indeterminate. Prof. Straus has recently examined the distal end of a thighbone and states that it is "wholly unlike the great apes." On the other hand, Dr. Broom has shown that the talus (anklebone) is close to the Bushman's, though the rounded bearing surface on the lower end is wider.

Most outstanding to a scientist were the teeth, but here again the question can be raised, "Where do apes stop and men begin?" The boundary line is, of course, arbitrarily set by man, not by nature. The canine tooth was not long and fanglike, as it is in modern anthropoids, especially in the males. The teeth were arranged in a palatal arch almost like that in a human skull, and from the wear on the grinding surfaces it was clear that their owners had chewed like human beings. The milk teeth of *Australopithecus* were almost identical with the milk teeth of a Bushman child, Dr. Broom found, and in some important characters very different from those of apes.

Also, the milk teeth referred by him to *Paranthropus robustus* were amazingly similar to a Bushman's. Could they by any chance *be* those of ancient Bushmen? Here the geologists Charles L. Camp and George B. Barbour agree with Dr. Broom that no modern Bushman could possibly have become fossilized in association with Broom's specimens.

Even a cursory examination showed that these fossils, like the Taungs Skull, were going to be of more than ordinary interest to science. In 1929, Dr. Dart had written of the original discovery: "The geographical position of the Taungs deposit showed for this anthropoid an environment which up to that time had been regarded as impossible for an ape. We never knew before of an ape which lived on a cliff or plateau overlooking broad, forestless plains, on the fringe of a desert . . . Geography showed us that it was an impossible kind of ape — a terrestrial, fleet-footed, or cursorial ape. It was an animal-hunting, flesh-eating, skull-cracking and bone-breaking ape. It was a cave dweller. It was the most generalized of all apes."

These creatures stood upright like man, but they only weighed 100 pounds or so. Their brains, though very small by human standards, were much larger in proportion to their bodies than in any modern ape. In fact, the ratio of brain to body approached that of man. They lived in groups, hunted in packs, crushed the skulls of captured baboons with the leg bones of antelopes, and may have had some sort of speech.

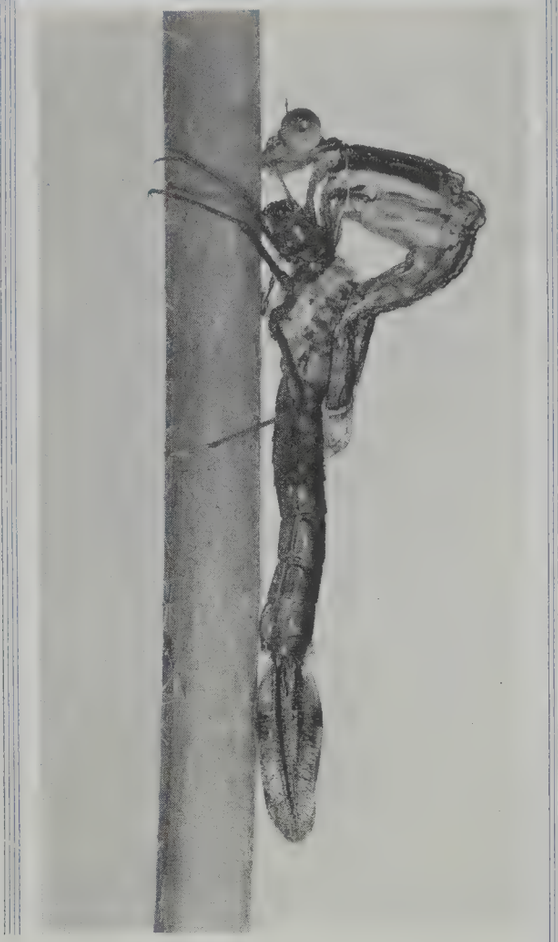
The question of how long ago these animals lived has evoked much lively debate. Ordinarily, beds of rock can best be dated by the species of animals found in association with them. But in South Africa, the fossil animals found in association with *Plesianthropus* and *Paranthropus* are local types that have no close relatives among the animals of Europe and Asia, where the standard geologic column has been worked out.

The animal remains are fairly abundant, however, and future researches will help greatly to clear up this question. Most of the animals were desert or open-plains types. With *Plesianthropus* were found a saber-toothed tiger, golden moles, two types of baboons, antelopes, and hyenas, and in a near-by cave were found some horse teeth. With the Taungs specimen were found small extinct baboons, their skulls crushed neatly as though with particular antelope leg bones, which, in fact, sometimes fit the dents. Other creatures from the Taungs caves include a hyrax, a mole, a shrew, two types of antelopes, a rock rat, and several ordinary rats. Gert Terblanche's *Paranthropus* skull from Kromdraai presented greater difficulties, because it was weathered out from an outcropping that showed few other bones, although there was some fine breccia not far distant that may have been contemporaneous. In it are horses, baboons, saber-toothed cats, pigs, foxes, hyenas, and jackals.

The animals found in the three deposits would seem to belong in the Lower Pleistocene period, which began about a million years ago, or in the Upper Pliocene, which preceded it. Dr. Broom thinks that all may be safely assumed to be over 750,000 years old and that many may be well over 1,000,000 years old—probably 1,500,000 years, perhaps even more. Thus he believes that a few belong in the Lower Pleistocene but that most are from the Upper Pliocene. Support for this latter theory might appear to lie in a special type of hyena known only from the Pliocene and found in the Sterkfontein caves

Continued on page 333

▲ WHEN ITS TIME IS RIPE, the bulbous-eyed nymph climbs a plant stem to a position a little above the water surface. Note its curious leaflike tail appendages, which look like the tail fins of some fish but are, in reality, the water-breathing gills



▲ ANCHORING the tarsal claws securely, a slow pumping action soon produces a dorsal rupture just forward of the wing pads, and a hump of the new animal appears

▲ THE FOLDED AND CRUMPLED WINGS soon seen, prophetic of the creature's ing mastery of the air

Debut of a Damsel Fly

A fairy of the upper air, which "down the listed sunbeam rides resplendent"

By WALKER VAN RIPER
Denver Museum of Natural History

All photographs by the author

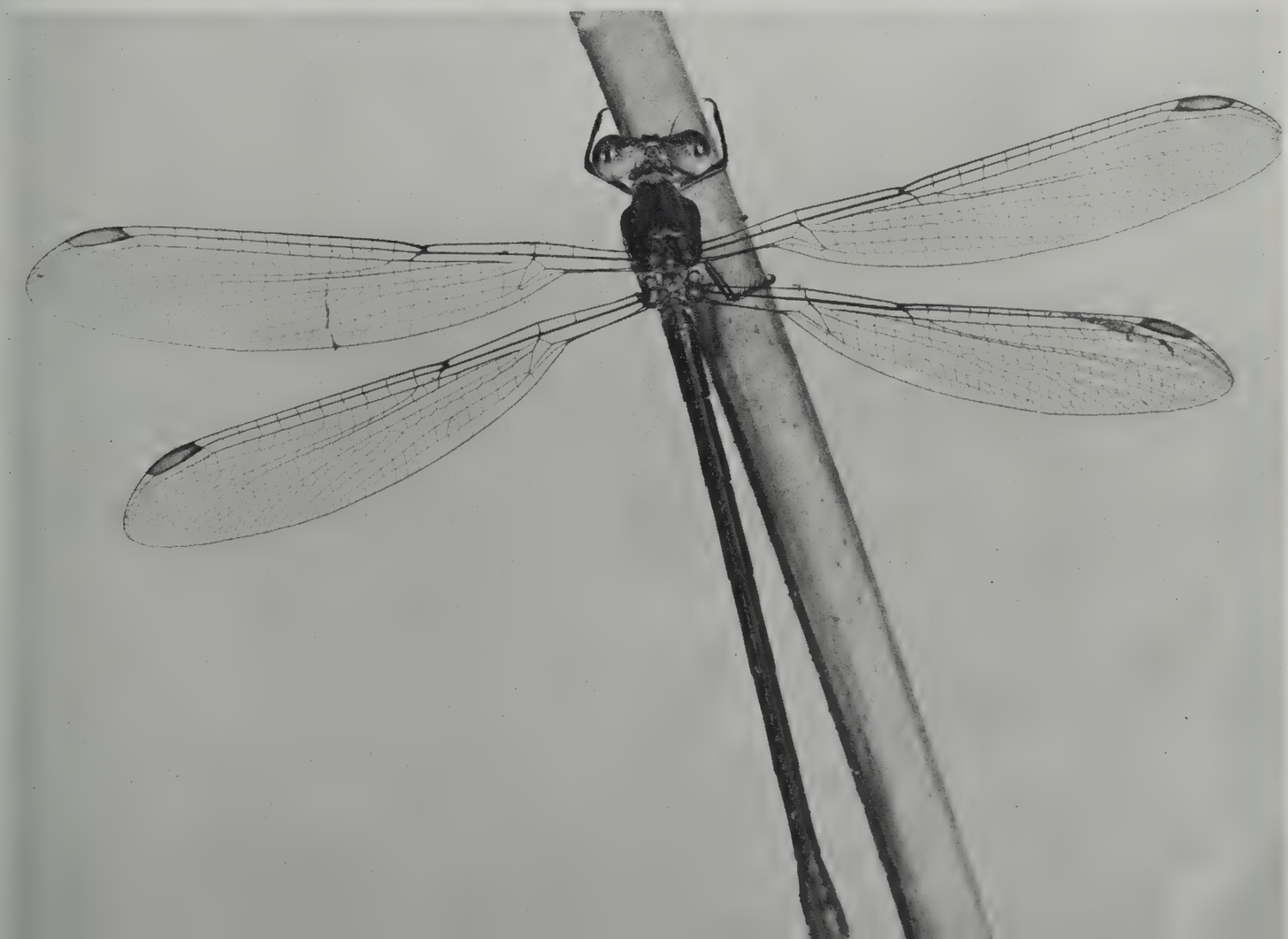
THE spectacle of the transformation from nymph to damsel fly is common enough in nature, yet it is not often seen. The voracious nymph lives in stagnant ponds and has curious forward-shooting, grappling tongs with which to capture its prey. This unattractive creature becomes a beautiful, mosquito-eating damsel fly of the upper air. It completely changes its form and mode of life during the period of an hour or more. This is a time of great risk and danger, for the insect is entirely helpless, incapable of flight or other movement and an easy prey to its chief enemies—birds and frogs. For the most part, the risk is avoidable if the insect undergoes its transformation before the break of day, and such has become its general habit. This is the reason, of course, why the process is rarely observed.

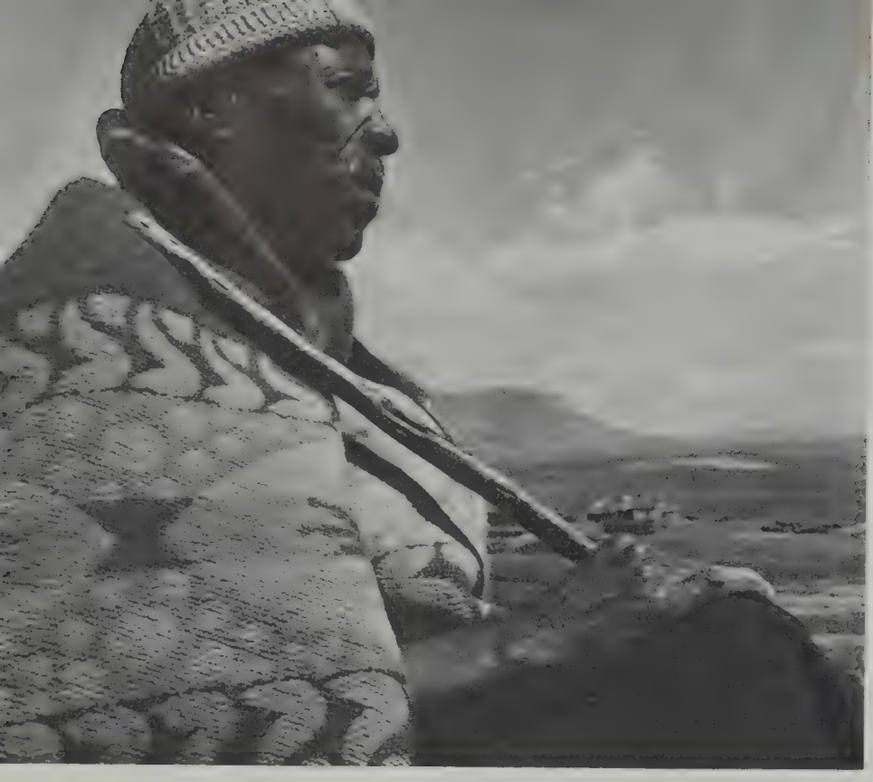
The accompanying pictures were taken with a high-speed electric flash, the exposures being about 1/5000 of a second at aperture f.32. The subject is a stalk-winged damsel fly of the family Coenagrionidae.

▲ SLOWLY THE WINGS unfold, and the abdomen lengthens considerably

▲ THE WINGS FLUTTER, delicate and gauzelike . . .

▼ . . . AND OUT of its ugly shroud, a diaphanous new damsel fly is ready to become air-borne





▲ A BASUTO ELDER looks out over his country

▼ A BASUTO HERD BOY: a common Basutoland sc
Schoolteachers have a hard time teaching these you
sters, for their attendance is erratic. A Basuto has li
use for money in the bank and measures wealth
terms of cattle and sheep. This has led to soil eros
from serious overstocking. Most young men pay
their brides in cattle

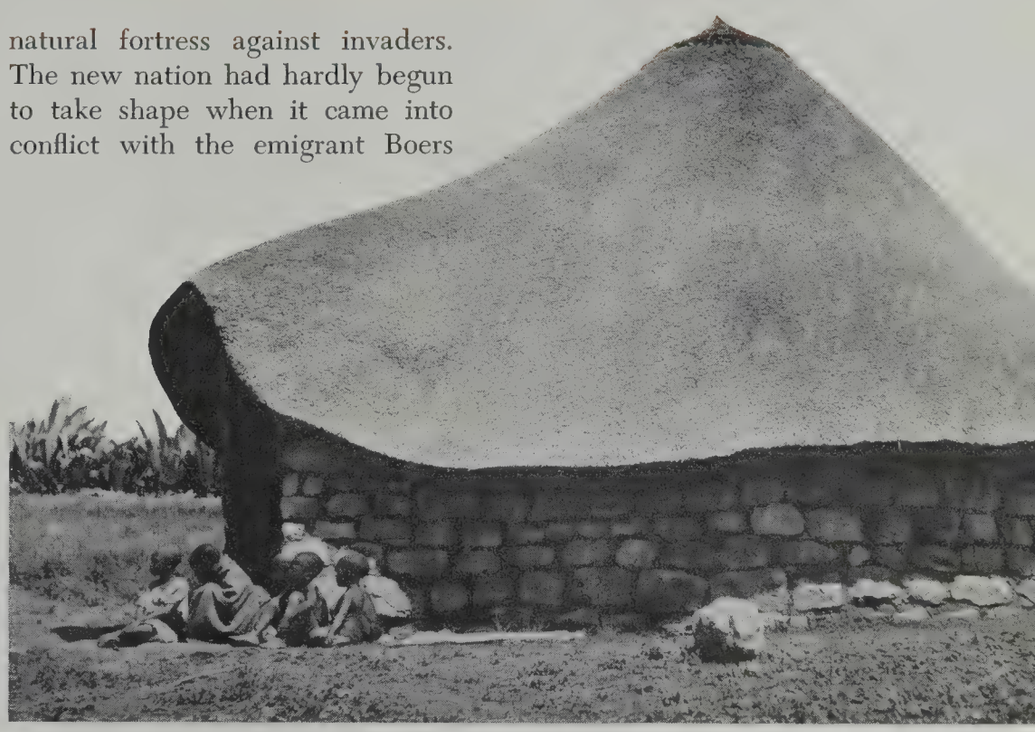
Basutoland

By Constance Stuart

Welded together almost a century and a half ago under the genius of their great leader Moshesh, the Basutos seek to retain their cultural identity and their right of self-determination under the awakening influence of modern education

FROM about 1820 onward, Moshesh, a young chieftain of insignificant stock, succeeded by his diplomatic skill in gathering together the remnants of tribes that had been scattered by the raids of the Zulus and the Matabele. He settled with them in the mountains of Basutoland, which formed a natural fortress against invaders. The new nation had hardly begun to take shape when it came into conflict with the emigrant Boers of the Great Trek, commonly called the Voortrekkers, the result being that the Basutos lost part of their territory. Moshesh thereupon appealed for and was granted British protection, under which a series of Paramount Chiefs have ruled ever since. The Basutos thrived as a nation and now have the largest population of the three protectorates that come under the British government's "indirect rule"—Basutoland, Swaziland, and Bechuanaland.

During World War II, 20,000 Basutos formed part of the African Pioneer Corps and served in the Mediterranean area. In 1947, the nation staged a great *Pitso* (meeting) of welcome for the Royal Family at Basutoland's capital,

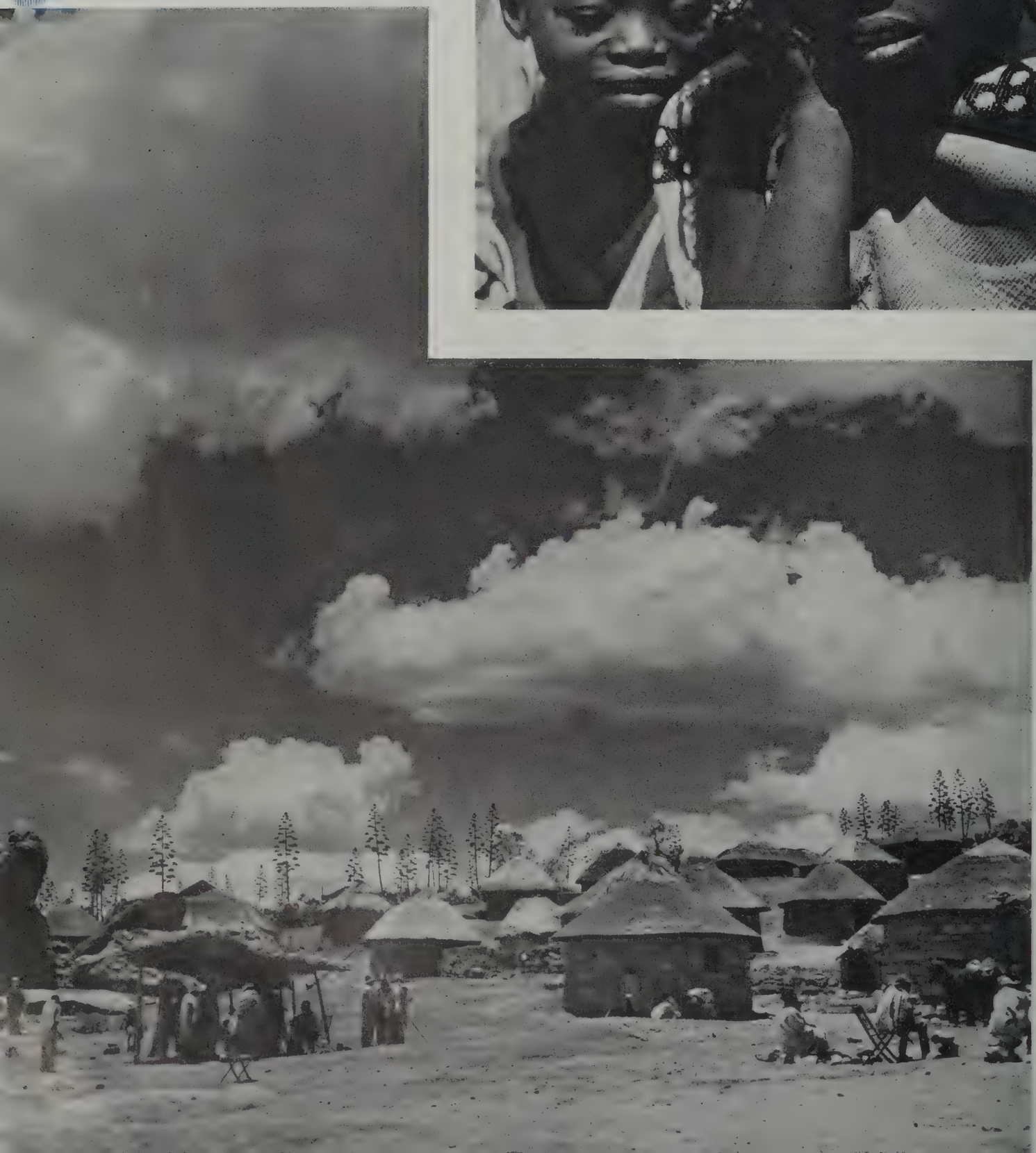


➤ A BASUTO HUT. Nowadays the walls are often made of stone, because there is very little timber

➤ SOME OF THE HUTS have a fence of reeds around them for privacy. The reed curtain rolled up above this doorway can be lowered

➤ THIS HERD BOY wears his weather-beaten straw hat at a rakish angle. His young brother smiles shyly in the background like a little French gargoyle. Herd boys as young as five are not an uncommon sight

▼ AT THE PARAMOUNT CHIEF'S KRAAL, or village. On the left is one of the "courts," where the head tribesmen meet daily to listen to cases of cattle theft, domestic troubles, etc.



Maseru. Thousands of Basutos rode for days from far up in the mountains and from the plains to be present at the greatest gathering of their people in many years. The small capital was filled with these colorful horsemen.

Basutoland has an area of 11,000 square miles—comparable to the state of Maryland—and a population of over 600,000. It is a native territory without European settlers or landowners and is governed by a system of "indirect rule." The Basutos swear their allegiance to a single Paramount Chief, under whom there are many lesser chiefs. Many of these chiefs

E TRADING STORES are a center of contact with the outside world. the Basuto buys blankets, shirts, European hats to wear on ys, and yard goods. The more ambitious may even buy shoes, will hurt the native's feet, for he is unaccustomed to such conent. He can walk hundreds of miles in his bare feet

▲ SUMMER AND WINTER the Basuto wears his characteristic blanket of gay and varied design and color. Before the days of traders, skin clothing and (in cold weather) a simple undecorated cloak sufficed. Today the Basuto buys his blankets at European-run trading stores, which are scattered through the territory. The hat is woven of grass by the Basutos themselves

▼ THE MEN RETURN from the mines for six months at a stretch to enjoy the pleasures of family life and to look after their domestic concerns. Most Basutos own a little land where they grow corn and graze their stock

▼ BASUTOS COMING HOME from their stretch of work in the gold mines, 600 miles away in Johannesburg. The bus stops to allow them to buy potatoes and oranges from a roadside vendor

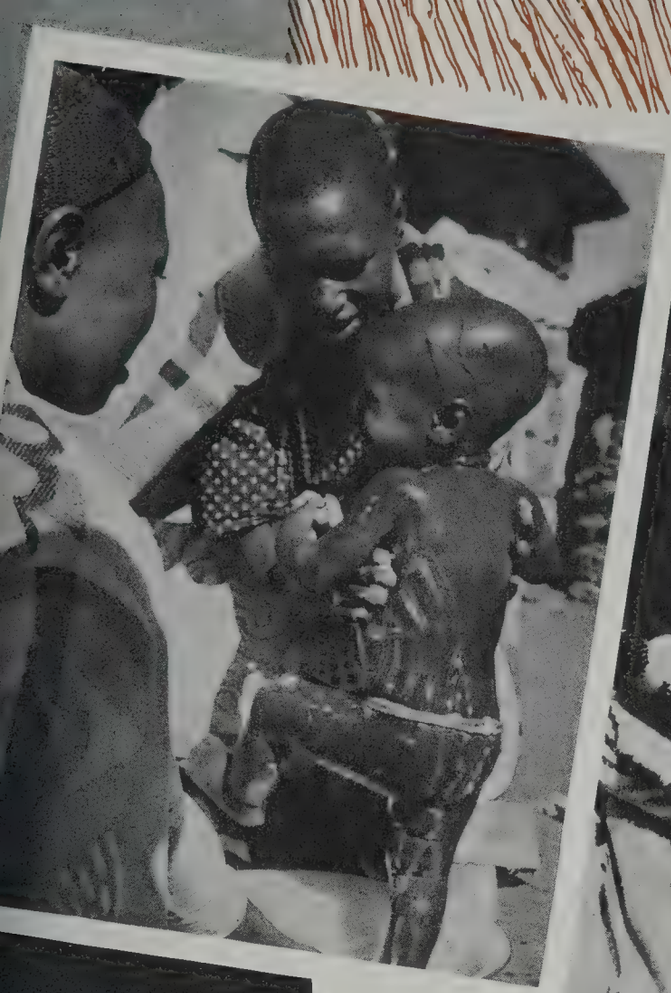
▲ A Basuto mother and child

are related to the great Moshesh and are collectively known as his "sons."

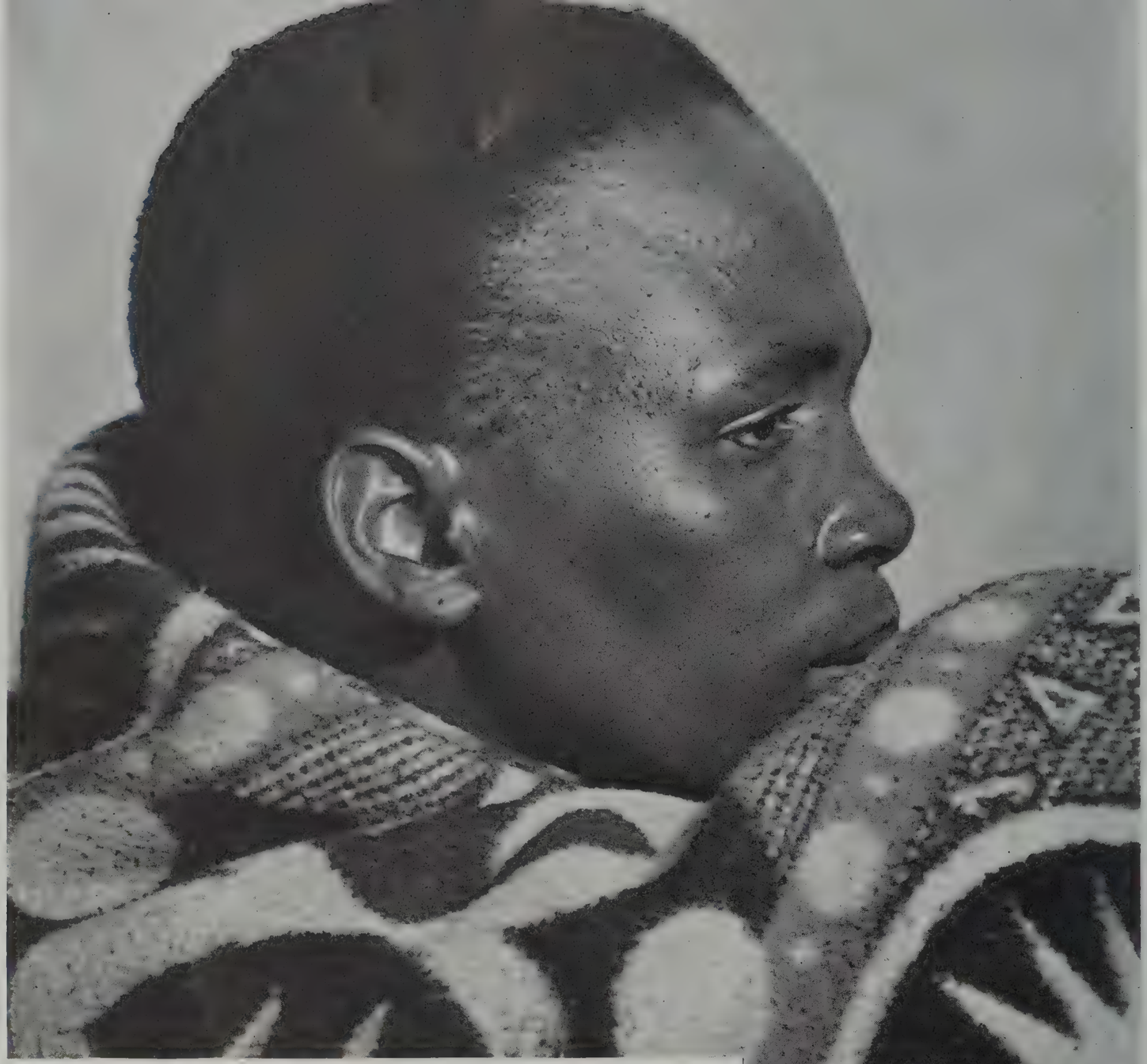
The visitor finds this one of the most picturesque of native territories, with its ranges of mountains, its men clad in colorful blankets and riding Basuto ponies, and its well-built thatched villages, grouped at the foot of the mountains.

Education is considerably affected by the mountainous nature of the country. There is a tendency to concentrate the schools in the lowlands, which comprise only one-third of the country, to the detriment of the remaining two-thirds. In spite of this, a strong feeling for education exists among the Basutos, and this is doing much to combat the traditional witchcraft and superstition. But "ritual" murders and pagan initiation ceremonies are still practiced in villages less than a day's ride on horseback from the capital.

Basutoland subsists on its agriculture. In the lowlands, the main crops are maize and kaffir corn, which is grown during the Southern Hemisphere's summer. The heights above 8000 feet are termed "cattle post" areas and are used for



HAVING A BATH in the European fashion, rather than in the river



▲ BASUTO WOMAN. Hair longer than this is seldom seen

◀ HORSEMAN OF BASUTOLAND. The "Basuto pony," a breed developed locally, is famous throughout South Africa for its hardiness and sure-footedness on mountain trails

grazing, livestock being moved to them from the lowlands for the summer and back again for the winter months.

The chief exports to the Union of South Africa are wool, wheat, and cattle. The arable land is insufficient to maintain the population, and many thousands of Basutos are recruited yearly to the mines, to industrial centers, and to farms, from which they send back their contributions to the national wealth.

There are few roads on which cars can travel in Basutoland, but there is a network of bridle paths up into the mountains. Thus one can reach any village or any part of the country by horse or by sturdy Basuto pony. The only railway in the country is a track one mile long, which connects Maseru with the Union of South Africa.

▲ A LITTLE BASUTO GIRL, who even though young, displays the natural dignity of her people

▼ THE BASUTOS WEAVE these immense baskets to hold their corn in winter. Talking to the youngster is a daughter of the Paramount Chieftainess

A "Little Yellowstone" that operates—of all places—in the dry-as-dust Nevada desert

NEVADA'S VALLEY OF GEYSERS

By NELL MURBARGER

Photographs by the author

IT was an old Nevada miner who first told me of Whirlwind Valley. He described it as a place where scalding steam jetted from fissures in an opal terrace, where crystal pools pulsed with boiling water, where mud pots blubbered, and ominous rumblings issued from subterranean grottoes. This was fascinating campfire talk, and I put it down for just that. I had camped and explored in every county and mountain range in Nevada, and if such a place existed, it seemed impossible that I shouldn't have heard of it.

Several months later, B. F. Couch, Librarian of the Mackay School of Mines, at Reno, assured me that the miner's tale was more than idle talk, that there was such a field of thermal activity about seven miles southwest of Beowawe, in Eureka County. So little was it known, he said, that my ignorance of it was altogether understandable.

Originally discovered by white men about 1867, Whirlwind Valley had been first described in a feature article by Albert S. Evans, published in 1869 in the *Overland Monthly* of San Francisco. More than two generations seem to have

▼ DESERT CONTRADICTION: steam rising from a hot pool in the barren flats of Whirlwind Valley. This is the largest of the five springs in the valley floor

elapsed before a second report was issued—a technical treatise in the *American Journal of Science* for March, 1934. It was prepared by T. B. Nolan and G. B. Anderson of the United States Geological Survey following "a few hours" spent in the study of the area in August, 1932.

"So far as we can find, nothing further has been published on the district," Mr. Couch said.

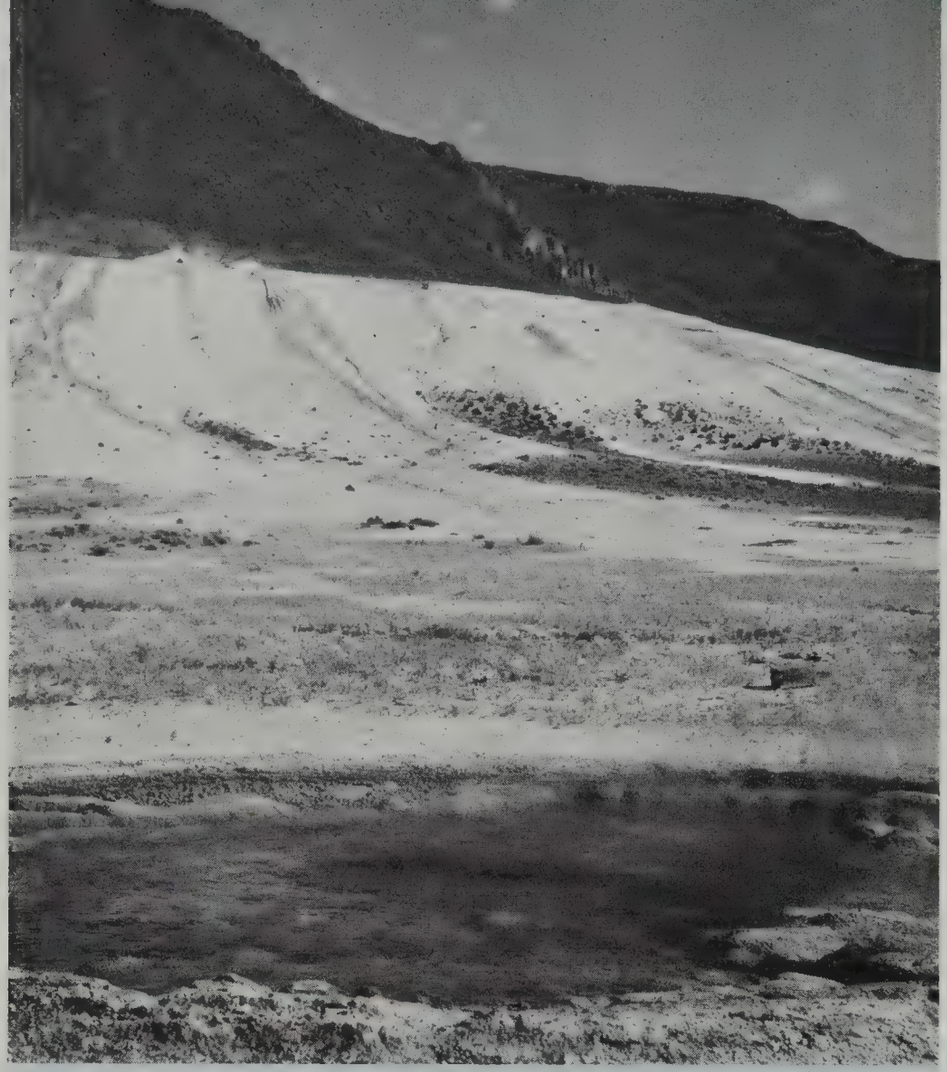
From the Nolan-Anderson, report, I gathered that the Whirlwind Valley geyser field was not exactly a second Yellowstone. Yet the idea of boiling water gushing from central Nevada's dry-as-dust desert ranges was, in itself, a prospect sufficiently alluring to draw me to the place at the first opportunity.

After provisioning in the small desert village of Beowawe, my companion—Dora Tucker—and I headed out across a broad, white alkaline flat. In giving us directions for finding the geysers, the storekeeper at Beowawe had said that for five miles our road would consist of nothing but the bosom of this flat and that in crossing it we must maintain a sharp watch to avoid wet areas.

"Not that there's any actual water on the flat," he said, "but there's underground seepage. Occasionally you'll come to areas where the powdery white surface of the ground appears slightly darker. That means it's wet just beneath the crust—not only wet but practically bottomless! If you're careful to stay clear of these boggy areas, I think you can make it—un-

▲ ERUPTING at irregular intervals, the largest geyser on the terrace shoots hot water and steam to a height of 25 or 30 feet

◀ SEVERAL SMALL GEYSERS, such as this one, erupt to a height of two or three feet



▲ THE COLOR-STREAKED SINTER TERRACE (*middleground*) is the area of greatest thermal activity. It includes low-spouting geysers, hot bubbling springs, blubbering mud pots, and subterranean caves

▼ STEAM SPIRALS from the vents and hot-water pools at the lower end of the sinter terrace. The roarings and rumblings of the disturbed waters produce an unearthly effect

less you get caught in a rain!" Critically appraising a handful of clouds on the eastern horizon, the storekeeper glared sternly at us and wagged an authoritative forefinger. "Just remember!" he warned. "If it starts to sprinkle, *get out of there, quick!*"

For the first mile or so out of town our two wheel tracks clung precariously to the top of a low, narrow dike. Then we came to a sheep fence, and letting ourselves through the gate, we found the dike at an end. Beyond that point we had our choice of a dozen "trails" which wandered willy-nilly over a broad, white expanse, as desolate and barren as the bed of a dry borax lake. Rising abruptly to the right and left of the flat were rocky, brown mountain ranges, and ahead of us the South rim of the valley was lost in a misty blueness.

Mindful of advance warnings, I eased the car along half dubiously. We had driven about half a mile when the first of the treacherous "dark" spots suddenly appeared. I swung sharply aside and halted the

▲ THE LARGEST SPRING in the flat b terrace occasionally displayed eruptiv of unusual agitation and churning. times the water showed its highest temperature

THE AUTHOR inspecting one of the opaline collars that have formed about the larger geysers on the terrace

MANY OF THE ACTIVE GEYSERS are surrounded by mounds such as this one, composed of opal fragments loosely joined together in a form resembling coral

car. Wheel tracks showed where other recent travelers had failed to spot the bog in time. Pulverized greasewood, mud-plastered burlap sacks, chicken wire, and splintered boards showed that a long and laborious struggle had been necessary to free the vehicle that had plunged into its hubs. From that point onward dark spots appeared with increasing frequency, but eternal vigilance and a five-mile-an-hour pace kept us free of trouble.

So intently had our eyes been riveted on the flat ahead that we were nearly to our destination before we first glimpsed the jetting steam and water. This was it! Mentally, I apologized to the old miner whose veracity I had doubted.

Soon we were close to the rocky hills bordering the flat on the east. We were traveling at the foot of a sinter terrace that stretched along the range for a distance of a half mile or more, its rim about 250 feet above the valley floor. Chiefly white, the terrace was streaked with shades of yellow, rose, and brown, and steam spiraled from it in a dozen or more places. Additional steam was rising from a group of hot-water pools situated on the flat near the base of the terrace.

HE AUTHOR'S CAMP in the Valley of ers. Despite the presence of water, the e flat is virtually barren of vegetation, mably because of the chemical content e springs on the soil

The largest of these lower springs was shaped like a twelve-foot morning-glory. A small opening ten feet below the surface connected it with the subterranean water supply. For a few minutes after our arrival, the pool lay so clear and quiet that grains of course sand were plainly visible on its floor.

Gradually, gas bubbles half as large as a man's head began rising from the submerged entrance, and the water started creeping up the sides of the rock basin. Within a few minutes the surface had risen a foot. It was pulsating and churning vigorously and beginning to overflow the pool. Gas bubbles were now escaping with such intensity that the water level in the central portion of the spring was six to eight inches higher than on the sides.

As excess water drained away, the pool gradually settled back to its normal level and in a short while again stood motionless, without ripple or quiver. Timing the operation, we found that the complete cycle of rising, overflowing, and subsiding was repeated every twenty minutes. During the period that the water stood quietly, its temperature registered around 162 degrees F., but at the apex of its eruption, the thermometer showed a temperature of 170 degrees—only about 33 degrees below the boiling point in this elevation of nearly 5000 feet.

Six feet away was a small spring where the water showed less movement and slightly lower temperature; and fifteen yards to the southwest lay a third spring in which the water likewise rose at twenty-minute intervals. Strangely, the low stage of this pool appeared to coincide with the high period of the largest spring.

Owing to the high alkalinity of the deposit, the entire flat was virtually barren of vegetation, but one of the near-boiling springs was completely enveloped in a jungle of salt grass—a jungle that swarmed with the largest and hungriest mosquitoes in all Nevada!

We found that water from the big spring, though not exactly pleasant, was far from unpalatable. A pint jarful collected here showed a mineral content of 1100-odd parts per million—a count that health experts frown upon but do not consider positively injurious. Were one contemplating actual use of the water, consideration would naturally have to be given to the type of minerals it contains. Water from the big spring contained 415 parts silica—an extremely high figure—but experimentation with a cake of toilet soap showed that it hadn't the slightest trace of hardness. There was no odor of sulphur, generally so prevalent in areas of thermal activity.

A dozen plumes of steam rising from vents in the big terrace directly above us tempted us to explore, but as the sun already was dipping low over the range to the west, we decided to make camp and wait till morning.

But there were a vast number of clouds in the sky, and they were entirely too red. They spelled rain. We had already seen enough of the alkali flat to realize what danger rain could bring, for once the top crust was uniformly moist, it would no longer be possible to detect the treacherous pockets beneath.

Several times in the night I awoke and peered hopefully from my sleeping bag, each time praying for the sight of stars shining in a clear sky. But each time I saw only fast-scudding clouds that covered and uncovered the moon. Periodic flashes of lightning revealed ghostly white spirals of steam still rising from the terrace, and an occasional low rumble of thunder threw over our camp a strange eerieness.

About dawn we were awakened by king-sized drops of rain splashing into our faces and spatting on the car and the canvas tarpaulins covering our beds. We lost no time getting into action.

As we hurried through our breakfast, my eyes shifted from the rain clouds to the terrace that beckoned so enchantingly.

Dora read my thoughts. "Why don't you go on up there?" she said. "I'll stay here and pack the car, and we can leave the minute you get back."

Although fully mindful of the old storekeeper's warning, I wanted so much to view the terrace that I grabbed my camera and tripod and headed up the steep, rocky slope at the best speed I could muster in the half light of 5 A.M.

Little vegetation grew on the mineral-impregnated slope except at one point where an overflow of iron-laden water from the geysers had cut a red sluiceway down the wall. Closely bordering the vile-looking stream was a luxuriant fringe of shooting stars, or wild cyclamens—the only ones we noted anywhere in the vicinity.

It was a difficult climb, at times very steep. The overflow of water had saturated large areas of the soil, leaving it slick as grease. Reaching my destination, I pulled myself over the sharp lip of the terrace and looked out upon a rocky ledge, nearly 100 feet in width and a half mile long. An amazing color-streaked ledge, it was strewn with every variety of thermal activity, from low-spouting geysers and hot bubbling springs to blubbering mud pots and subterranean caves. The roarings and rumblings were unearthly—nearly as ominous as the thunder then rolling over the desert mountains to the east.

Although it was nearly sunrise, the sky was dark with heavy clouds, and the light was very weak and inadequate. I determined, however, to photograph as many of the springs and fumeroles as possible, and, at the same time to take a census of their number.

All the active geysers were surrounded by mounds of siliceous sinter, largely composed of opal fragments loosely cemented together in a form resembling coral. In some areas this opal showed a distinct blue-green cast, due, presumably, to the presence of algae. Other sections of the terrace presented a smooth surface of solid white opal, exhibiting occasional glints of rose or iridescence. Of the mounds surrounding vents, few were more than a foot in height,

but one I noted had built up an opalescent collar at least three feet thick. Blocks of basalt, which had lodged on the terrace after rolling down the steep slope above, had also been covered with layers of the sinter.

While nothing about the mud pots appeared especially unusual, Nolan and Anderson tell us in their monograph that ten per cent of the mud consists of diatoms, which the U.S. Geological Survey has classified into ten species. Of these, three were noted as "rare," two as "frequent," and five as "common."

In my necessarily swift census, I counted 57 vents or boiling springs —many of them hot little pools not more than 12 to 18 inches in diameter. A considerable number of these showed gas bubbles and a small overflow but could not properly be said to erupt. Altogether, I feel certain that the area must embrace more than 100 live outlets, as well as a great many apparently inactive vents.

The sky was growing darker, a chill wind was coming in gusty blasts, and the puddle-sized raindrops were striking with increasing frequency. So I reluctantly left the strange scene and hustled down the steep face of the terrace to join my partner, who was waiting for me.

Since we could still see the wheel tracks we had made the previous afternoon, our crossing of the boggy flat was accomplished in short order. Reaching the safety of the dike, we halted momentarily to look back.

We could still discern the summits of the Cortez and Shoshone ranges, now raked by dark, rolling storm clouds. Between them, however, lay only an ominous blue-gray void. Whirlwind Valley, with its steam jets, mud pots, and strange sinter terrace, was completely lost to view in a black downpour.

▲ THE SPOONBILL holds its neck straight in flight, unlike its heron and egret neighbors

the ROSEATE Spoonbill

It has gained ground in Texas and Louisiana but remains rare in Florida.

By HUGO H. SCHRODER

Photographs by the author

YOUNG roseate spoonbills are not born with a silver spoon in their bill. In fact, in spite of their name, they emerge from the egg without any spoon! Only adults have the unique flat bill that has earned them their name. The bill of the chick more nearly resembles that of a duck, and some time must pass before the broadening becomes evident.

Though an adult spoonbill is not a handsome creature when viewed head-on, its plumage was a much-desired commodity in the days when traffic in bird feathers was unlimited. In Texas, Florida, and Louisiana, where the spoonbill was once numerous, settlers and plume hunters killed it ruthlessly. Its feathers are pink, with vivid carmine on the wings; and fans made

of the wings brought an attractive price. Like egrets, the curse of beauty almost led to the complete extinction of the spoonbill before feather traffic was outlawed and protective legislation passed.

Today egrets are commonly seen over a wide area, but spoonbills are still quite localized in their nesting. They have made a welcome comeback in Texas and Louisiana, but in Florida there seems to have been no halt in their decline. A small number still nests in certain regions of Florida, and they are known to wander into other parts of the state during summer and early fall, but the sight of a "pink curlew," as they are locally known, is a red-letter event to most bird observers.

I had been in Florida nearly a decade before I discovered my first spoonbill. This was in Mosquito Lagoon, east of Titusville, and several years later I saw another wandering spoonbill there. They have been seen in this area by other observers from time to time.

But I had to go to Texas to see spoonbills nesting. There I saw considerable numbers on islands in Galveston Bay—islands under protection of the National Audubon Society. Several hundred pairs nested there, along with American egrets and various other herons.

What a beautiful array of spoonbills I found one day, strung out from a sand bar in the bay—some 60 of the pink adults, lined up in the shallow water—a wonderful sight! On one island there were numerous spoonbill nests in low shrubbery, all with either eggs or small young. One nest contained two eggs and two youngsters, one just emerging, so I had an exceptional opportunity to record how the infant's bill appears at birth.

The other island contained a larger spoonbill nesting concentration. These nests had to be viewed from a distance; but it was possible to observe and photograph the birds from a hide-out in the shrubbery. All the nests appeared to contain well-grown young. There were frequent squabbles between neighboring spoonbills and between the spoonbills and their egret neighbors.

Roseate spoonbills nest only in tropical and subtropical regions and breed from the Gulf southward to the pampas of Argentina. Low shrubs and trees are favored nesting sites, but they have been known to build their nests on the ground. Nest building begins soon after the birds pair off and is completed during the mating period. This is a busy time for the male, for it is his responsibility to guard the territory from enemies and to gather the

nest-building materials. He delivers twigs and sticks to the female, and she works them into the nest.

Spoonbills brood once a year, and on the average, two or three eggs are laid. The incubation period is about three and a half weeks, during which the male relieves the female at intervals on the nest.

Although the feeding of the young in the nest was always too distant for me to film successfully, I was able to observe the procedure. When the parent spoonbill returned to the nest with a supply of food, Junior would thrust his bill into the side of the parent's bill and partake of his dinner. When the young leave the nests, they learn to search for food in the shallow waters where the spoonbills regularly feed.

The feeding process is an unusual one. Moving about in the shoals, the spoonbill swings its bill from side to side until the prey is located. This motion seems to be instinctive, for Robert Porter Allen, in his thorough study, *The Roseate Spoonbill* (National Audubon Society, N. Y., 1942), points out that hungry spoonbills in captivity will "wag" their bills even when food is not available. The bird does not scoop up its prey but rather grips it, forceps-fashion, between the tips of the bill and then lifts and shakes its head, sending the food into the throat. The bill is equipped with sensitive nerve endings that are valuable "feelers" in muddy waters, where prey cannot be seen.

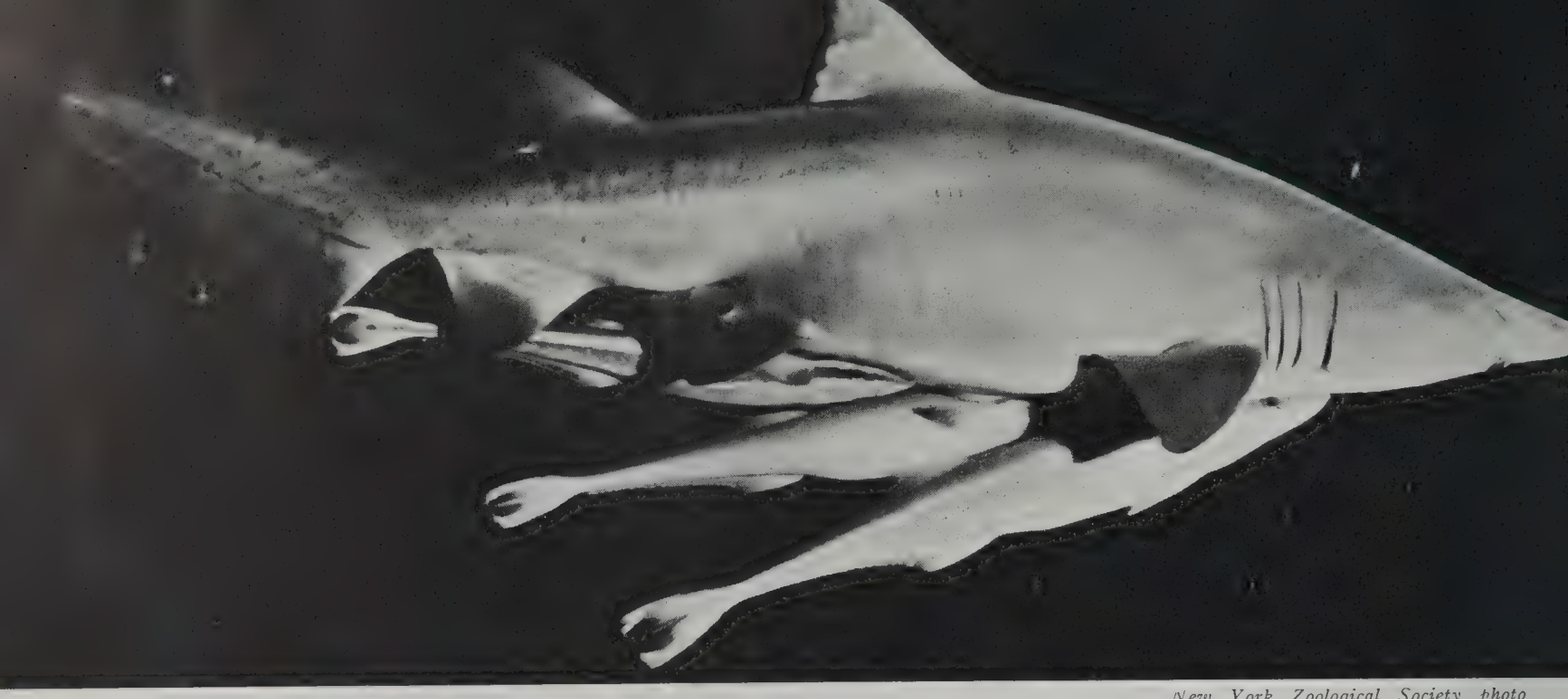
Spoonbills frequently raise their wings for balancing when moving about in the treetops. They present a colorful picture in flight, with the pink of their plumage outlined against the blue of the sky. The dark carmine shows beautifully on the wings with each downstroke, and is particularly vivid when a flying bird makes a sudden turn at close range. The spoonbill holds its neck straight in full flight, unlike its heron and egret neighbors. When coming in for a landing, the bill is pointed downward.

Leaving the islands of the spoonbills was like leaving a beautiful flower garden. The vivid markings on the bird's wings, in contrast with their delicate pink plumage, presented a sight long to be remembered. That departure was made on a June day in 1941 and was my farewell to the "pink curlews," for in the intervening years not a single roseate spoonbill has come my way.

Spoonbills in flight can be seen among other large birds in the entrance exhibit to the Hall of the Biology of Birds in the American Museum of Natural History.—Ed.

◂ ROSEATE SPOONBILLS and an American egret in Galveston Bay, Texas. The spatula-shaped bills are clearly seen when the birds perch in the treetops

▾ A FEW DAYS OLD: At birth there is no sign of the spoon-shaped bill that distinguishes the adults



New York Zoological Society photo

▲ REMORAS attached to a Sand Shark. They will share the shark's meal when he finds it

HITCHHIKER *of the Sea*

The fish that rides free to its meals lends itself to one of the strangest fishing methods known

By N. J. BERRILL
McGill University

WHEN Columbus returned to the Caribbean the year after his first voyage of discovery, he was in less of a hurry to get back to Spain and took more time to explore. He found Cuba to be a lovely island, and it was during a leisurely voyage among the islets off the south coast, which he called the Gardens of the Queen, that Indians came in a canoe to hunt turtle with a fish.

The Admiral himself watched while they fastened a cord to the tail of a curious fish and let it go down into the sea with the line held to the canoe. The explorers who were with him recorded their observations as follows: These fish "have a large mouth all full of suckers like a cuttlefish, and they are very daring, as ferrets are here. And when they are thrown into the water, they go to fasten themselves on some fish; of these they do not leave hold in the water but only when they are pulled out . . . they had one of these fish fastened on the bottom of a large turtle, and they waited to get it into the canoe." The description is not quite accurate, for the suckers are not in the mouth but on the top of the head. And while Columbus was not familiar with the fish, it is one that was well known to the ancient civilizations of the Mediterranean.

The fish was the Remora (pronounced REM-o-ra), otherwise known as the Shark-sucker. Its peculiarity is that its dorsal fin, which starts life like the dorsal fin of most other fishes, changes into a complex sucker or adhesive organ shaped like the sole of a shoe and divided into many compartments. The fish uses the sucker to hitchhike from one place to another. By means of suction it attaches itself to any convenient large swimmer of the seas, whether it be a shark, turtle, porpoise, or even the manatee, which Columbus called the mermaid. This is pure laziness, for what the remora gets is a free ride to a free meal. It attaches by the back of its head to the lower side of its traveling companion and hangs on till the meal is reached. Then it drops off long enough to join in the feast, after which it reattaches and goes for another ride. And there is little doubt that the hull of a ship looks as good to the remora as the belly of a shark.

There is a very old legend that the remora can slow down sailing vessels and even stop them altogether. We repeatedly find the idea in medieval and classical literature, and the fish was often drawn on Greek and Roman vases. In fact, the death of the Emperor Caligula was attributed indirectly to a remora, which was supposed to have fastened to his great galley and held it back while the rest of his fleet escaped. Its scientific name, *Echeneis*, itself means "holding back," and older writers usually referred to it as the Ship-holder. The remora is never big enough to exert much force against a moving boat. One kind reaches a length of about sixteen inches, and another about three feet. There is little doubt, however, that a rowboat or small sailboat would be slowed down by

one of these underwater hitchhikers, and several of them might make their presence known to the oarsmen of a larger boat. Mark Anthony's delay and defeat at the battle of Actium was also supposed to have been caused by the attachment of many suckerfish to his galleys. Perhaps any excuse was better than none, especially when Cleopatra may have been the real reason.

The remora fastens itself very tightly. It has been reported, for example, that when one is attached to the glass of an aquarium, it will hold so firmly that the sucker is left attached to the glass, and the fish is so injured that it dies.

Another old name for the suckerfish is the "Reversus," from the mistaken idea that the fish swims on its back. It does give that impression, but it actually swims in the normal manner.

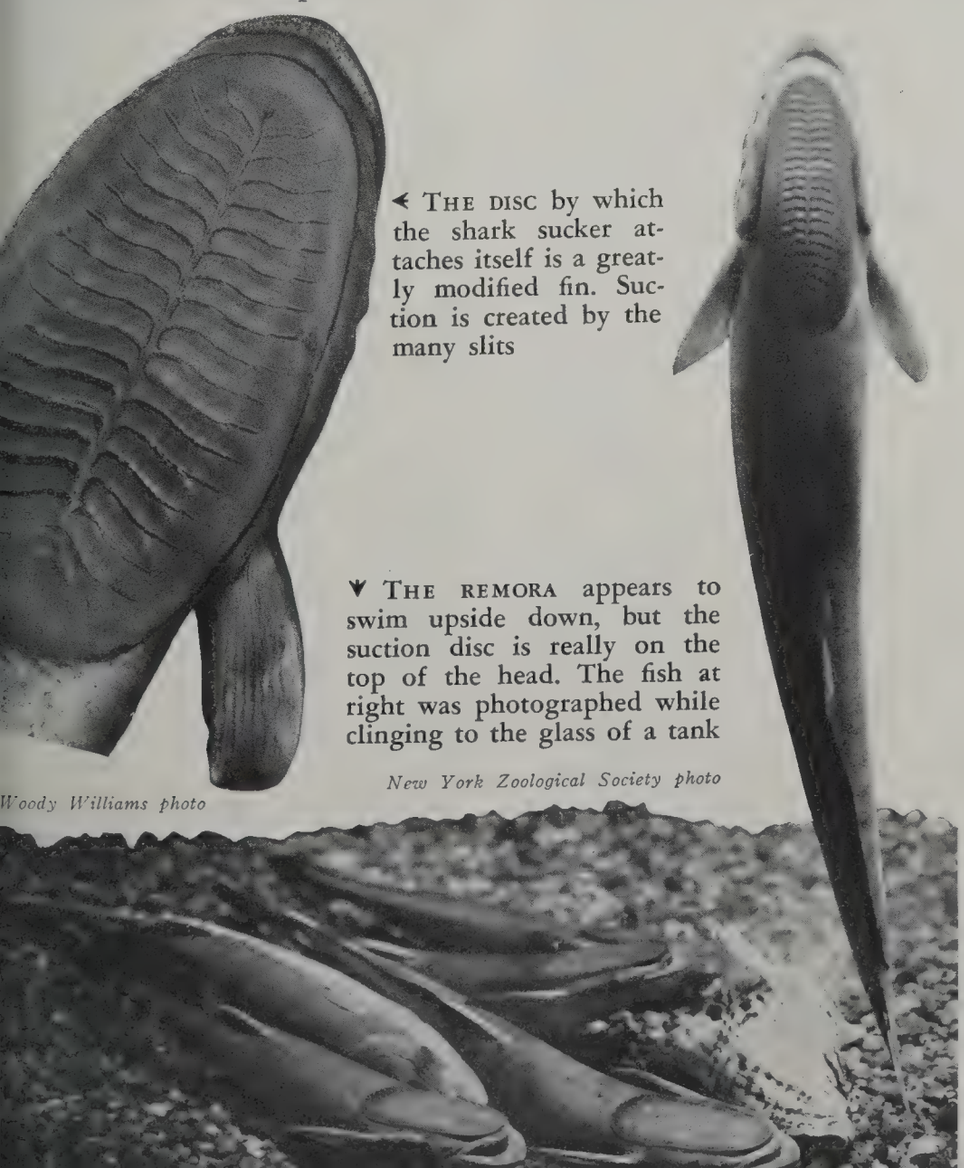
According to reports left by Columbus and his companions, the Caribbean Indians caught these curious fish when they were young and raised them in pools. Before and after a hunting trip below the sea, the Indians would talk to the fish, cajoling and praising them as though they could understand.

There is something very strange in the widespread use of this method of fishing. It reflects either the wanderings of mankind or the tendency of men throughout the ages to use their ingenuity in every possible way to obtain food beyond their reach. There is no doubt that man is inherently lazy and will make someone work for him if he can. But is it not surprising that the remora is employed to hunt fishes, turtles, and other sea animals, with a cord fastened to its tail, not just in the West Indies but in Malaya, China, the Spice Islands, and northeastern Australia? Chinese, Polynesians, Melanesians, and Australian aborigines isolated from the rest of the world for thousands of years, as well as Carib and Lucayan Indians of the West Indies, all use or have used the same fish in the same way. It does seem more reasonable to believe that the statement "Great minds think alike" accounts for this widespread practice, rather than that the method was discovered only once and was then carried over so large a part of the world.

The aborigines of the Barrier Reef angle for suckerfish with hooks made from pearl shell or bone fastened to woven bark lines. Then they fasten the fish by the tail and keep it in shallow water until it is time to hunt for turtles. In leashing the fish, a hole is made at the base of the tail fin by means of a turtle bone, and one end of a very long piece of string is inserted and made fast to the tail. A short piece of string is also passed through the mouth and out the gills, securing the head end, and the fish is slung over the side of the canoe. When a turtle is sighted, the short piece is pulled out of the mouth, and away the remora goes. As a rule, just before the fish is released, the disk and shoulders of the sucker are scrubbed with dry sand to remove the slime and excite the fish.

So long as the line is kept taut, the remora cannot let go of anything it has caught, and the size of the turtle or fish that can be captured is limited only by the strength of the line and the breaking strain of the remora itself. Turtles up to 100 pounds have been hauled to the surface in this way. But when the turtle is very large and clings to the bottom (and green turtles can weigh several hundredweight!), the natives dive overboard and follow the line down to the turtle to secure it with a rope.

One little difference stands out between the customs of the aborigines of Australia and the gentle Indians described by Columbus. Whereas the Indians endowed the remora with intelligent understanding and treated the fish humanely, the Australian aborigines at the end of a day's fishing eat the remora, too.



Woody Williams photo

◀ THE DISC by which the shark sucker attaches itself is a greatly modified fin. Suction is created by the many slits

▼ THE REMORA appears to swim upside down, but the suction disc is really on the top of the head. The fish at right was photographed while clinging to the glass of a tank

New York Zoological Society photo

For a detailed account of the use of remora in native fishing, the reader is referred to Dr. E. W. Gudger's study published in *The American-Naturalist* in three installments: July-Aug., 1919, Sept.-Oct., 1919, and Nov.-Dec., 1919.

Can Music Charm Snakes?

By Bucky McDonnell

An account in which an amateur naturalist and a professional scientist arrive at opposite conclusions

I SHALL tell you exactly what I observed and then, because science says, "No, snakes cannot even hear music," you will hear from a man who states his reasons for doubting the interpretations I offer. I do not promise that it will be easy for you to make up your own mind.

One morning about 10 o'clock in the early part of September, I was playing my violin on the southeast shore of Lake Tiorati, west of the Bear Mountain Bridge, New York. I was right at the edge of the dam that forms the bank on the southeast end of the lake. My friend, Art Bisson, who is a great music lover, was sitting on a camp chair, holding the music so that I could play it while looking over his shoulder from behind.

I had played several classical and semiclassical numbers, when suddenly my friend started to fall over backward, chair and all. I stepped aside and looked down to see what had caused him to turn turtle so easily. A big snake was half curled up where the chair had stood. Art said he felt it weaving in and out around his bare feet. We disposed of the snake.

Since there were many snakes in that neighborhood, we did not see anything strange about this. Art again took his position holding the music, and I continued to play. He kept looking around for more snakes, and before long he said, "Look, Bucky, here comes another one right up to me." I stopped playing. Art got rid of that snake and then sat down a third time.

It wasn't long before he said, "Bucky, you are a snake charmer. Here come two more snakes."

I did not think I was a snake charmer, so I stopped playing and watched. In a minute or two, they turned and started to crawl back to the woods. Art said, "Start playing, Bucky." I started playing, from memory, some of my own compositions. The snakes immediately turned around and came back toward us.

I said, "Well, if I'm a snake charmer, let's see if there are any more snakes," and I started to play. Another big snake came crawling out of the woods, and I watched it as it came toward us. It vibrated to the music I was playing, and as I changed the tempo of the music, it changed its vibrations. We walked around the spot in the clearing where we could watch the snake, and the snake followed me around as I played.

When I stood in one place and played, the snake came to within about six feet of me, curled up, raised its head about five inches, and just sat there like a statue until I got tired playing.

We let this snake crawl back to the woods. But when I picked up my violin and played a final tune, friend snake came back to his original place to listen. This last one, I believe, was a black snake. As I remember it, there was a black snake, a water snake, and several garter snakes that had come out.

This was my first experience, and I did not think there was anything unusual about it. I supposed that others had done it, but one day I was telling the postmaster in our town about it. He also had a camp on Lake Tiorati. He said he had never heard of such a thing, and I told him I would show him.

About two weeks later, I was sitting on a stool near his camp, playing my violin, trying for all I was worth to bring a snake out of the woods. Nothing seemed to happen. The postmaster and his guests started to kid me. Then a boy came around the bend and said, "Did you see that puff adder right back of you?"

I turned around to look, and there the snake was, sitting about three feet from my head on the dam, in exactly the same position as the first snakes I had "charmed." I stopped playing, and soon it went away. I played again, and it came back.

Then I tried something new. I put my violin away and got my mandolin. I played to the snake for about ten minutes. It never made a move to go but seemed to be in a trance.

Since then, I have mentioned this

story to many and have not found anyone who has charmed snakes with a violin or a mandolin. Many people did not believe my story and invited me to demonstrate. I have proved the thing to many of these folks.

Not long ago, my friend Charles Kenny of the New York *Daily Mirror* heard about this. He talked it over with many of his friends, and they all thought it couldn't be done. This was especially true of Herman, Charles Kenny's farmer, who worked on the Kenny's Connecticut farm. Charles Kenny, incidentally, also plays the violin, and Herman knew where there were black snakes.

One day, Charles invited me up to his farm for a week end. I said, "All right, I'll bring the fiddle, but I won't promise anything. I only know that it attracts New York and New Jersey snakes."

At the Kenny farm the following week end, Herman told me of his doubts about snake charming. Charles tried to tell him that I was an honest fellow, but Herman only looked dubious. In addition to my own violin, Charles had five others ready for the demonstration.

Saturday morning was beautiful —warm sunshine and a nice southwest breeze blowing over the countryside. Charles said, "Is it all right for a little snake charming?"

Charles took his fiddle, and I took mine. His wife and son went along. Herman ushered us to a place on the farm that looked like black snake country. Charles and I played together. Nothing happened. We played and played—still nothing happened. Herman seemed satisfied, but Charles still had faith in my word. I concluded that there just weren't any snakes within hearing distance. Herman was sure there was at least one.

We were all about to give up when Charles suggested I play alone. I did, and in about two minutes Herman's eyes almost popped out of his head, and his brow wrinkled. "Mr. Kenny," he said, "look at the big black snake coming along the wall." There was Mr. Black Snake half out of the rocks coming toward me.

I said, "Now you fellows stay here, and I'll go on the other side of the wall. If the snake goes through the field-stone wall, you will know the violin is causing him to do it."

I played on the opposite side and, in about a minute, the black snake went through the wall and crawled to about six feet from me. The snake curled up, raised its head about six inches, and sat as if in a trance. I played to him for about ten minutes.

Herman shook my hand and said, "I'll believe anything you say now, Bucky." Charles was also surprised and impressed. He only seemed to worry that his playing had not appealed to the snake.

Having had these experiences, you may understand that it is a bit difficult for me to reconcile actual observation with expert testimony, which says that snakes do not have an eardrum and cannot be assumed to hear music.

Charles M. Bogert, Chairman of the Department of Reptiles and Amphibians at the American Museum of Natural History, comments on my observations as follows:

"Several investigations have shown that hearing in snakes is defective, if not altogether absent. And it is well known that the flutelike instrument of Hindu 'snake charmers' has nothing to do with the reactions of the cobras used in such spectacles. These snakes characteristically raise the forward portion of the body and spread the so-called hood when disturbed. They simply focus their attention on the moving object nearest to them and follow its movements. The cobra would perform its 'swaying dance' in front of the swaying fakir in the same manner regardless of whether the instrument were played or not.

"Unfortunately, some of the scientific experiments performed to test the hearing of snakes have not been sufficiently well controlled to prove very much. E. Mangold reported that in 1913, when a trumpet was sounded near snakes, there were changes in the breathing rate and other responses. Ten years later, F. B. Manning made tests with rattlesnakes and found that they were unaffected by loud sounds (in octaves with vibration rates from 43 to 2752 per second) produced in a receiver scarcely a foot away from their heads, except in the case of the lowest notes. A Japanese investigator, Ryo Kuroda, observed the breathing responses of nineteen different kinds of snakes and obtained no evidence that they could hear a loud bell.

"One of the difficulties in controlling such experiments lies in the fact that vibrations from sound are transmitted to the body of the snake through the substratum—the floor of the cage in a laboratory and the ground in natural surroundings. This accounts for the apparent hearing in snakes in spite of the fact they have no tympanum, or eardrum. The bone that ordinarily leads from the inner ear to this membrane in other reptiles is in most snakes attached at its outer end to the bone that forms the support for the lower jaw. Thus the response that Manning obtained with the low notes could have resulted from vibrations transmitted through the body of the snake to nerves more closely associated with the sense of touch.

"A somewhat more reliable way of finding out whether snakes actually hear was employed by E. D. Adrian in 1938. Using suitable apparatus to detect nerve impulses, he found that loud sounds failed to produce any kind of activity in the nerve known to be concerned with hearing in other vertebrates.

"Inasmuch as the sounds produced by Mr. McDonnell's violin or mandolin could have been transmitted through the ground to the tactile nerves of the snake, the question of whether snakes can actually hear in the ordinary sense of the word is perhaps more or less academic. It does seem doubtful, however, whether vibrations of the intensity produced by the musical instruments mentioned could have carried for any distance into the 'woods.' If these vibrations were transmitted to the body of the snake, why should it respond by

approaching the source of the sound? I know of no evidence to indicate that snakes employ auditory cues in finding either their prey or their mates.

"On the other hand, black snakes (*Coluber constrictor*) are apparently attracted during the mating season by movement. Several naturalists have observed that these snakes will sometimes approach and investigate the movements of a person. In Arizona, Mr. William Woodin, III and I were trying to capture a racer (*Masticophis flagellum*) by approaching it slowly in order not to frighten it. As we crouched on opposite sides of the motionless snake a few feet away from each of us, it suddenly started to crawl with moderate speed in the direction of Mr. Woodin, who remained as still as possible. To his astonishment, the snake paused briefly as it reached his trouser leg, and then, with rather deliberate movements, seized with its mouth a fold of Mr. Woodin's trousers. Seemingly the action was an investigatory one, although the interpretation of such field observations is of necessity speculative.

"The point I wish to make, however, is that the sounds from the musical instruments may have had nothing to do with the behavior of Mr. McDonnell's snakes. The behavior of the black snake suggests the possibility that the movements involved in the playing of the instruments might have attracted the snake. My guess is that if he had gone through the motions of playing without producing any music, the snakes would have moved in to investigate just as readily as they did when sounds were emanating from the violin or mandolin.

"Mr. McDonnell does not mention having kept a careful record of the times and conditions when he may have sat playing his instruments without attracting snakes. Anyone playing a musical instrument near Lake Tiorati, or just sitting, for that matter, is almost certain to see a snake from time to time. No information is supplied here to exclude the possibility that the snakes' vision was involved, as pointed out above. And absurd though it may seem, olfaction should not be completely ruled out. Odors indetectable to human nostrils certainly register in the olfactory organs of a snake, but this is unlikely to explain the attraction of a violin or mandolin.

"Quite candidly, on a basis of what is known about the nervous system and the behavior of snakes, it is unbelievable to me that the interpretation offered by Mr. McDonnell is correct. However, in expressing my skepticism, I am not seeking to deter anyone from adding to our knowledge concerning the creatures of the wild. I am only urging that observations be reported objectively, with a clear distinction made between what was actually seen and what was merely inferred—perhaps erroneously. Also it is necessary that the circumstances surrounding the observations be given in some detail."

LUNGLESS SALAMANDERS

Continued from page 304

"bridge" (if one ever existed) across the Atlantic. Thence they could conceivably have migrated to Europe, where they are now found. It seems unlikely that the European species could have been accidentally carried in ships, because salamanders are not known to "hitchhike" with cargo the way some other animals do. Also, it would be hard to explain how the European species could have split into two races in the short interval since the earliest voyages.

Today about 85 species and subspecies of plethodontids are known from the United States. There are many species in Mexico and Central and South America. New species are constantly being described by the more than 20 salamander detectives investigating salamander abodes in the different parts of the country. They study salamanders meticulously and often find that among uniform patterned salamanders and those otherwise alike in nature, several species and subspecies are discernible after close study, including the use of such tools as statistical analysis.

Herpetologists are often impressed by the variety of patterns and colors that often blend into a salamander's background. For example, Moore's salamander, *Leurognathus marmorata,* is so mottled above with shades of buff and gray that the salamander is difficult to discriminate from the stream bottom. On the other hand, contrasting characters are not so easily explained. The red-cheeked salamander, *Plethodon jordani,* appears to have rouged its jaws, in contrast to the deep blue-black body. The yellow-blotched salamander, *Ensatina croceater,* vividly-hued with black and orange blotches, lives in seclusion in leaf mold and beneath rotting logs in southwestern California.

Voice plays no part in the breeding process of salamanders. Actually, they have no vocal cords. But this did not prevent Professor C. C. Abbott, usually a careful zoologist, from brashly describing one of the large salamanders as having "a clear, bell-like note . . . It is a true hylodes note . . . They call, whistle, or give tongue, as you choose to express it, only in spring and at the time when the females are depositing their eggs." The call was obviously a frog call, probably a hiding spring peeper, *Hyla crucifer.* Many observers have heard faint squeaks emanate from plethodontids that were roughly handled. In all these cases the sound was probably accidental and associated with a sudden emptying of the mouth cavity. Some salamanders will go into a "death feint" when handled. This cataleptic state lasts but a few minutes, and a sudden touch or movement will arouse the creature to activity again.

It is difficult to believe that the concerted study of these small amphibians has consumed a substantial segment from the lifetime of such famous amphibiologists as Dr. H. H. Wilder and his wife, the late Dr. G. K. Noble, Dr. E. R. Dunn, Dr. Sherman C. Bishop, and many others. What has prompted these scientists to labor on salamanders, of all the manifold living forms, makes interesting speculation. Actually, plethodontids are not of any real economic value outside of their negligible insectivorous habits. Their martyrdom to science should be their most important commendation. Much has been written about these creatures, from Benvenuto Cellini's musings in 1524 over why salamanders issued out of a fireplace, to Nelson G. Hairston's excellent ecological study of plethodontids in the southern Appalachians in 1949. But far more information remains shrouded in their secretive habits.

European folklore of several centuries ago tells us that salamanders gamboled in fires without getting burned. Even today we hear people repeat the same myth, as if nothing has been learned about the creatures in all these years. Many questions remain unanswered, particularly concerning their reproductive habits. Two species (*Hydromantes genei italicus* and *Oedipus adspersus*) give birth to living young. Diligence and specialized scientific training will be necessary to solve some of the riddles. But one thing is certain—both the specialist and the amateur naturalist will always take pleasure in the pretty colors and spritely nature of the plethodontid salamanders.

EARLY "MISSING LINKS" FROM AFRICA

Continued from page 309

in association with a baboon that was contemporaneous with *Plesianthropus*. But caution bids us wait. This problem demands and will receive close study through many related branches of science. The hyena may prove to be a South African survivor from the Pliocene. In the next few years, the South African fauna may be correlated with the record from China, India, Java, and elsewhere, and then a much more definite answer can be given.

Dr. Broom studied his three genera and noted that they differed from apes in many ways, and in each of these ways they resembled human beings. They substantiated the conclusion that man and the anthropoid apes forked apart not a few hundred thousand years ago but perhaps many millions. With their small canine teeth and short jaws, these creatures were almost men. Their nearly human limb bones indicated that they could stand up and walk erect and that they did so to the exclusion of other forms of locomotion. Dr. Broom's findings thus far indicate that the female *Plesianthropus* had a brain with a volume of from 450 to 500 cubic centimeters, about the size of a large fist. It was thus not far from the range of the chimpanzee or the gorilla, the average for the female gorilla being 435 cubic centimeters. Last year a large *Plesianthropus* jaw was found, and Dr. Broom calculated that a skull large enough to go with that jaw must have contained a brain of 650 or perhaps 700 cubic centimeters—not so far below the capacity of 900 cubic centimeters ascribed to Java Man (*Pithecanthropus erectus*). Modern man usually has a brain of 1200 to 1500 cubic centimeters, although the extreme range is from 850 to over 2000. Anatole France had a 1100-cubic-centimeter brain and Dean Swift's was over 2000 cubic centimeters. Dr. Broom has noted that in many primitive races the brain may be as small as 1000 cubic centimeters or less, although a pre-Bushman race had the largest brains in the history of the world.

In structure the Sterkfontein fos-

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sil's brains were not unhuman. Dr. G. W. H. Schepers, a brilliant student of Dr. Dart's who became a medical practitioner and a well-known anatomist, studied with minute care the convolutions in casts of the brain cases of the Sterkfontein, Kromdraai, and Taungs skulls. He decided that the front two-thirds of *Plesianthropus* was "much more man-like than ape-like." The latter one-third was subhuman, he found, but at that, it approached the human brain in form. From his study of the brain cases, Dr. Schepers decided that *Plesianthropus* had some sort of speech, and that it could use its hands for manipulation of tools, rude though such implements undoubtedly were. Prof. W. E. Le Gros Clark thinks there is no evidence of speech in the brain cast.

The study, Dr. Schepers said, suggested that "these fossil primates were closely related to man's ancestral stock, if not actually Pliocene or Pleistocene surviving representatives of his Miocene or Pliocene evolutionary predecessor." No creature, he believed, could be accepted as human unless it could stand up and thus relieve its hands from the necessity for aiding in locomotion and, secondly, until it had developed some sort of speech or other means of communication. The brain casts of Dr. Broom's fossils indicated that they may have scored like little men on both points.

"The least we can say," wrote Schepers, "is that these fossil types were capable of functioning in the erect posture, of using their hands in a limited sense for skilled movements not associated with progression, of interpreting their immediately visible, palpable, and audible environment in such detail and with such discrimination that they had the subject matter for articulate speech well under control, and, having developed motoric centers for the appropriate application, they were also capable of communicating the acquired information to their families, friends, and neighbors, thus establishing one of the first bonds of man's complex social life. With all these attributes, they must have been virtually true human beings."

Emotion and Science

So vulnerable is man to vanity that some will resist the notion that these little creatures could have been our direct ancestors. To them, the fossil hunter appears always to be searching for skeletons in the human closet—unworthy forebears to sully the proud human escutcheon. Theological arguments are sometimes enlisted to support the thesis that Man, God's special creation, must not be linked with anything so lowly as a monkey. Those who yield to this conceit may take comfort in the admitted possibility that the Australopithecinae may be only our grand-uncles—closely related collateral beings not forming an integral part of the direct human stem. This may satisfy those who want to prolong the argument that we alone are God's own creatures. But meanwhile, more and more missing links are being discovered. And those who search for them are not made atheists by the fact that they are studying a creative process that took millions of years instead of an instant. Dr. Broom, for example, believes that in evolution there is a Plan and a Planner.

Naturally, the closer a given skull comes to being an exactly intermediate form, the more intense will be the argument as to whether it belongs on one side of the line or the other. Scientists sometimes differ in their interpretation of the details, but on the broad issues, there is more and more agreement as to the proper place of these important South African specimens in the evolutionary sequence. They belong much farther back than the other fossil men of which more has been written – *Pithecanthropus erectus*, Peking Man, and the others. They are apparently older than any other beings that show definite human-like traits. If you should meet them today on the South African desert, you might not at once call them human. But there is good reason to believe that they walked like men, that they used simple tools, and that they even may have talked.

BOOKS *Continued from page 295*

is a necessary adjunct to identification and to the study of insects.

The book is well arranged and satisfactorily illustrated. It is written for the amateur, and it will prove most useful to beginning students in entomology, particularly in the high school grades. Like other books of its kind, it contains much information not previously included in popular books, and the layman will find it interesting reading.

C. H. Curran

This Land of Ours

-------by Maxwell S. Stewart

Public Affairs Committee, Inc., $.30
32 pp. 36 illustrations

This unit in the extensive Public Affairs pamphlet series is addressed to and seeks to convince the city dweller that wise use of our natural resources is of vital importance to him. His dependence on the products of the land is emphasized in a series of beautiful photographs with simple explanatory captions. These cover two very different types of resources: those that are the products of a healthy land and with proper care are inexhaustible, like water, foodstuffs, and wood products; and those like coal, gas, oil, and the metallic ores that are subject to continuous depletion.

Photographs of healthy land and water and their living communities are interestingly contrasted with those showing the appearance of such areas after years of abuse. Even to laymen these should largely tell their own story.

In closing, the author points out that six out of every ten voters now live in a city and that it is therefore important for the city dweller to actively support the governmental efforts to help resource owners put conservation measures into practice.

Unfortunately, the whole presentation leans too heavily on the questionable assumption that everyone abhors resource waste and will do all he can to stop it once it is called to his attention. Human nature being what it is, the pamphlet would probably have gone much further in producing the results the Committee seems to desire if more space could have been devoted to proving that natural resource exhaustion hits the city man first, hardest, and where it hurts the most, namely in his standard of living. Much good, however, could come from a wide dissemination of this excellent piece of literature, and it is to be regretted that relatively few of the 90 million city dwellers who need its message most are likely ever to see this pamphlet, unless quantity production can lower the cost of distribution.

Richard H. Pough

At the End of a HURRICANE

By Harrison M. Reed, Jr.

PAPERS run headlines telling of a hurricane in Florida or elsewhere, with lurid accounts of death and destruction well illustrated with vivid pictures covering the disaster phase of the event. That is news! But what about the beauty of the storm? Many witnesses who have waited anxiously for a storm of this kind to pass have remarked that there was a certain grim grandeur about it all.

In Jacksonville, Florida, on the night of August 26, 1949, a hurricane came across the state from a southwesterly direction to hit this city "mildly," so the Weather Bureau said. But lights and phones went out, and highways were blocked by fallen trees and debris. By the morning of the 27th the east shore of the St. Johns River on the fashionable South Side was a riot of broken docks and tangled timbers as a result of winds that blew at 70 miles an hour with occasional gusts that reached a known velocity of 85 miles an hour. Then suddenly, on the afternoon of the 28th, the sun peeped through.

Here is an actual photograph of the tail end of a hurricane as seen over the St. Johns River from nearby San Jose community. Many witnessed this sight from various vantage points, but this seems to have been the only photographic record of the event. The local Weather Bureau states that this ending is typical of hurricanes. Suddenly, while the wind was still high, the rain squalls ceased.

The cloud layers appeared to separate, and while the lower strata (fractostratus) scudded madly onward, the upper strata (altocumulus) began to break up or coagulate into a flying mass of small fleecy clouds at an altitude of between 7000 and 8000 feet. Almost before a camera could be set up, the storm was over. Forty minutes after this picture was taken blue sky was a common and most gladdening sight, with only a few black rain clouds remaining in the distance (nimbo-stratus, seen in the background of the picture). Everywhere, of course, there was evidence of destruction, and the roar of the storm still rang in the viewer's ears. But they who came out to survey the damage were impressed by the magnificent cloud effect displayed in this mood of the elements as "Dame Nature" gathered up her winds, and a grateful people thanked their Maker that the hurricane had not been worse.

suet in a crevice in the tree, in different places.

Chickadees, Starlings, Blue Jays, and Woodpeckers all came for this suet, but the Nuthatch was the only bird that appeared to hide the food for possible future consumption. We thought that this information might be of some interest.

CHARLES and IRENE MUNZINGER.
Oakland, New Jersey.

The following comments are offered by Dr. John T. Zimmer of the American Museum's Bird Department:

This interesting trait of the White-breasted Nuthatch has long been known, although the origin of the practice is not clear. The chances are that the Nuthatches do not remember the caches as a future source of food in case of shortage. It is more likely that if the store is again visited, it is in the course of a general search for food, when it is as much a pleasant surprise to the birds as any other unexpected discovery.

The Nuthatches have another procedure that suggests a possible explanation of the behavior under discussion. Since their bills are not heavy enough to be very efficient crushing organs, certain harder items in their diet may be carried off and held under foot or wedged in a crevice where they can be hammered open. Inedible portions may be left where they were lodged, being of no further use. It is not impossible that the same treatment might be accorded softer bits of food, especially if there were an abundant supply waiting competitive attention. The birds' concentration on getting a full share of the main stock might drive out recollection of the previous cache.

This is pure speculation, of course, and the concealment of food may have had some other origin. Various other birds have the same trait. It would be interesting to learn if the Nuthatches were ever seen to return directly to their stores when food was not readily available elsewhere.

Foundling Seal

SIRS:

Almost every year during the past 30 years from one to six baby seals have been driven ashore in stormy weather on Parsons Beach, Kennebunk, Maine. They are a week or less old, and until last year, no one succeeded in keeping one alive. The seal shown in this photograph was raised on a bottle. It became as dependent and affectionate as a dog and very friendly with the dog. It had free access to the river, and after about four months it departed for the sea.

A lobsterman near Jonesport, Maine, had an almost identical experience, but I do not know whether that seal departed for the sea or remained as a family pet.

New York, N. Y. JOSEPH PARSONS.

Museum Visitors

More than 2,000,000 persons visited the American Museum during the past twelve months, according to Wayne M. Faunce, Vice-Director. Approximately 70,000,000 have visited the Museum since 1900. Annual attendance has more than quadrupled since that date and has nearly doubled in the past two decades.

In the Planetarium

During September, the subject of the lecture at the Hayden Planetarium will be "Autumn Skies."

Astronomy and Navigation

Five series of popular and informal lectures occurring once a week will begin at the Hayden Planetarium in September and October. These courses are carefully designed to clarify basic concepts in an authoritative yet not too technical manner. The introductory sessions, which provide an opportunity to ask questions regarding the scope of each course, are open to the public without change, as follows:

Modern Celestial Navigation	Sept. 20
Applied Navigation . . .	Sept. 25
Astronomy without Mathematics	Oct. 3
Young People's Astronomy and Parents' Refresher Course	Oct. 14
Star Identification	Oct. 19

All of the lectures begin at 7:15 P.M. except the Young People's Astronomy and Parents' Refresher Course, which is held at 9:45 in the morning.

A pamphlet giving additional information about these streamlined courses can be procured by addressing a request to The Hayden Planetarium, 81st Street and Central Park West, New York 24, N. Y.

Total Eclipse of Moon

There will be a total lunar eclipse on September 25, which will be visible in all parts of the United States.

Special

Exhibits at the American Museum

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YEARLING, head down	CAT	BLACK WHALE	ANTEATER	COLT	BISON
RHINOCEROS	GRAZING COLT	OWL	NEANDERTHAL MAN	FROG	REINDEER
HIPPOPOTAMUS	PIG	SQUIRREL	PELICAN	TURTLE	TIGER
SEA HORSE	MOOSE	GORILLA	DUCK	RED LOBSTER	GORILLA
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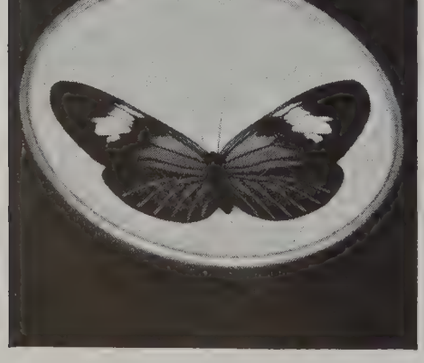

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LETTERS

Mighty Mississippi

SIRS:

Some of your readers may be interested in this photograph of the mighty Mississippi. Note that at this point, deer wade across the river with impunity. I photographed this scene last year near Lake Itasca, the source of the Mississippi, in northern Minnesota.

BATES M. STOVALL

Alexandria, Va.

Barter Mart

SIRS:

I am making for the local archaeological society, of which I am a director, a collection of minerals and rocks typical of those used by the Indians and early inhabitants of North America. I still need for this collection, specimens of obsidian, novaculite, jasper, and the several varieties of chalcedony (as described in Dana's *Mineralogy*). I wonder if any of your readers can help me in obtaining any of these. I can pay a moderate amount for good specimens but would prefer to trade minerals and rocks from the Missouri Ozarks for them.

I do not need perfect artifacts but can use broken pieces or even chunks of unworked material to show the general appearance of these rocks and minerals.

Any help to make this a good collection will be greatly appreciated.

C. H. TURNER

Springfield, Mo.

Flowers from the Crater

SIRS:

I am a student at Hiroshima-High-Normal School and am very much interested in collecting wild flowers. At Hiroshima Civil Information Education Library I found NATURAL HISTORY Magazine and am delighted with it. Within beautiful and good pages I can easily see about the animals and plants of the United States.

I hope it may be possible for you to introduce to me an amateur plant collector with whom I could exchange specimens. I could send him the wild flowers of Hiroshima City.

(Mr.) TERUHIKO KIDO
Age 20

Hiroshima, Japan

NATURAL HISTORY Magazine will be glad to forward to Mr. Kido and Mr. Turner any communications from readers interested in flowers and minerals respectively. Address: care of NATURAL HISTORY Magazine, 79th St. and Central Park West, New York 24, N. Y.

Jumping Fishes

SIRS:

In the June issue of NATURAL HISTORY you published a short article entitled "Jumping Fishes," by Bucky McDonnell, in which the author described how fishes can be made to jump out of the water by striking the gunnels of a canoe sharply with a paddle. I am wondering whether a slightly different experience I have had with fishes may interest your readers.

For years it was both my custom and pleasure to return to a cottage on the Susquehanna River a few miles north of the Pennsylvania-New York line. A college classmate joined me one summer, and we frequently rowed four or five miles upriver for corn roasts, dances, etc. In this part of the river there were several small rapids to be navigated, and to help us through these tough spots in

NOTICE—Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on these pages will be paid for at $3.00 each, with full credit to the photographer. Return postage must be included.

the dark we used a fairly strong auto headlight attached to a post in the bow or stern of our four-oared steel rowboat.

Some occasions required a bit more fancy dress than usual, and my story starts with a black night on which we were wearing white shirts. My friend was rowing in the bow of the boat when, all of a sudden, he got a wet slap in the back with an eight- or nine-inch black bass. The fish had jumped at least 2½ feet out of the water and then dropped to the bottom of the boat.

It is well known that fish are attracted by light, so we decided that our headlight had been responsible for this. Either it had made a bright spot on the boat or on my friend's shirt, or the light itself had attracted the fish and made it jump.

We then made trips at night to check our theories. We determined that if the light played only inside the boat, leaving the water dark all around, the results were surer. I should add, however, that there was nothing to boast about either as to the size or the number of the fishes.

Having proved our theory, we began to wonder whether by chance the regular nightly maneuvers of another boat we had seen had a similar purpose. It would slowly work its way up and down on the far side of the river, with a lantern in the bottom, looking like a phantom ship. There were laws about night fishing, and we felt that it was really the other man's business if he wanted to break them, so we went slowly. In time, however, we made his acquaintance. He lived in a small shack downriver. We got at the truth during a yarn-swapping session. With little idea of being believed, I timidly told of our experience of catching fish with a light in the boat. Our friend then confided that we had guessed correctly. Having only nights available, he was supplying a part of his food requirements in this way. He said there was nothing unusual about catching fish by means of a light, and he cited a case of a sunken canal boat that tipped considerably but had a dry deck area behind one gunnel. People would walk that deck at night with a lantern shielded behind the gunnel, and fish would be attracted. They would jump toward the light, and some would land on the deck and be carted home.

I was most interested in Bucky McDonnell's incident, but I do not have any explanation for these things. After many years of varied fishing, I am convinced that fishes rate high in the stupidity scale and that no one knows what is in their minds. They won't touch a good-looking worm but will take a dry fly and a cigarette butt on the same line (two hooks, of course) in the same cast. My one and only "muskie" (18¾ pounds) cost me about $25 a pound, taking all the trips and all the expenses into account—and then along comes one of them and gets himself caught on a stringer hanging to a post of the dock. But don't get me wrong. There is no thrill like seven inches of brook trout with his tail kinked against a fast-flowing stream and you on a slippery rock with light equipment. . . .

Westfield, N. J. W. R. Atwood

Catching fish by means of a varnished board sloping into the water from the edge of a boat is an ancient practice in China, where it was reported at least as early as 1685. Moonlight glittering on the board is frequently mentioned as one of the circumstances making it more likely that a fish will propel itself into the boat.

In a comprehensive article entitled "Fooling the Fishes," published in *The Scientific Monthly* for April, 1937, Dr. E. W. Gudger raised the interesting question of whether this method of fishing was carried from one region to another all the way to the Congo, where it has been observed in modified form. He finds no mention of the practice between Annam, or perhaps India, and the Congo basin. He concludes that, in all probability, the method was developed independently in different parts of the world.

Plausibility is lent this conclusion by Mr. Atwood's own story, above. Where there is intellectual curiosity, there is development in the arts of fishing. Like most fishing techniques, this one is designed to make the fish catch himself. Mr. Atwood clearly discovered the efficacy of a light in attracting fishes and unearthed the only instance resembling the Chinese varnished board technique that we have heard of in the United States.—Ed.

Dwarf Birds?

Sirs:

My interest in birds has spread to the rest of the family, including my nine-year-old son. Recently he saw a person whose growth had been stunted for some reason. Later he asked me if there were ever dwarfs among the birds. Could your ornithological department help me in answering that inquiry? Thank you.

Lorain, O. Mrs. J. C. Hageman.

The following comments are offered by Dr. John T. Zimmer of the American Museum's Bird Department:

It is quite possible that dwarf individuals may hatch on occasion, but certainly very few if any of them survive. Among the many thousands of birds that have passed through my hands, I have never seen one that I could call a true dwarf. There is, of course, individual variation in size as in other characteristics, the extent of which is different in different species, but it is nevertheless remarkable how small this variation often proves to be.

A notable difference in size may occur between populations of the same species living in different regions, and numerous subspecies have been named on such characteristics. The entire population of the different area is, however, involved and within its own limits of variation is as constant in size as the other. There is also sometimes a notable difference in size between the two sexes of certain

Continued on page 384

▼ Canvas sometimes took the place of the varnished board, as shown here. The net served to keep the fish from leaping clear over the boat. The artist seems to have erred in putting the moon on the far side of the boat

After Fortune, 1857

NATURAL HISTORY

The Magazine of the American Museum of Natural History

F. Trubee Davison, President | Wayne M. Faunce, Vice-Director In charge of Publications | Albert E. Parr, Director

VOLUME LIX—No. 8 **OCTOBER, 1950**

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THE COVER THIS MONTH

The gorgeous autumn coloration shown in Georgia Engelhard's photograph taken at Tamworth, New Hampshire, reminds us once again of the marvelous living chemistry that produces this aesthetic treat each year. What many persons do not realize is that these colors do not represent the transformation of one substance into another. The red, yellow, and purple substances are present in the leaves all through the year. But they are hidden by the green coloring matter known as chlorophyll until, at the end of the warm season, it diminishes and exposes them. Among these pigments are the derivatives of carotin, and the dye stuffs called anthocyanins (reds and purples) and flavones (yellows).

Perhaps the most pleasing effect is seen when a few green leaves remain, as in this view, and when nature's autumn palette is accented by the gleaming bark of birch, whose frosty whiteness will remain the same through the summer sun and winter snow alike.

This photograph was taken with Ansco Outdoor Color Film, at f 8 and 1/50 second, with an Eastman Kodachrome haze filter.

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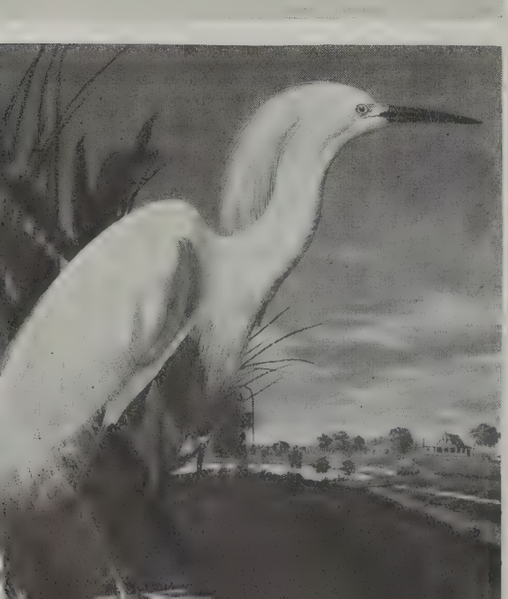

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Science Is a Sacred Cow • Game Abundance
Africa • Fishing • Gems

SCIENCE IS A SACRED COW

- - - - - - - - by Anthony Standen

E. P. Dutton & Co., Inc.
$2.75, 221 pp.

MR. STANDEN'S blast against scientists and the science that some of them profess has been received generally with whoops of joy by the reviewers in the daily press and with scorn by the critics in the scientific journals. There is no doubt that Mr. Standen is sprightly in his attack and often funny. The pleasure, however, that scientists might be expected to take in his cracks is apt to be somewhat wry. But even the scientists trying to be "objective" (Mr. Standen doubts this state of grace) must admit that the author has a point or two.

What Mr. Standen seems to be objecting to most of the time is that science or scientists are overweening in their claims and are often wrong. He points to a long list of errors stretching back to the beginnings of science. That doesn't impress me very much, since it is well known that scientists spend a large amount of their time altering and perhaps improving the concepts and theories of their predecessors. The fact that someone one or two hundred years ago formulated a generalization that is now discarded doesn't necessarily mean that everything we believe now is similarly doomed for a future ash can. Even Newtonian physics continues to have validity.

Another gripe of Mr. Standen's, especially when dealing—none too gently—with the social sciences, is that they cannot provide the answers to various pressing social questions. No one knows this more acutely than many social scientists. That is one of the reasons they are in the business of trying to find methods that will provide the answers. Of course this won't satisfy Mr. Standen, who seems to think that social scientists will never be able to solve their problems and perhaps should not be permitted to try.

I suppose in the long run, it is a question whether you believe, as Mr. Standen evidently does, that man can arrange his affairs better by intuition or revelation, or you sympathize with the struggle of the scientist to establish a firm foundation of tested and rational understanding as a basis for society.

HARRY L. SHAPIRO

LAST CHANCE IN AFRICA

- - - - - - - - - by Negley Farson

Harcourt Brace, $5.00, 381 pp.

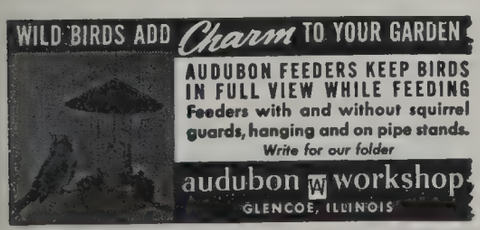
NEGLEY FARSON first visited British East Africa twelve years ago. In 1947, wishing to study the problems of both natives and Europeans, he traveled from Tanganyika to the Abyssinian frontier, visiting tribal chiefs, farmers, government officials, native educators, and Indian merchants. He was astonished at the unsolved issues—educational and economic. He found schools, maintained by the government, by missions, and by literate natives, "up for revision." "The white man should better educate the native for life in Africa"—provide training not only for clerks but artisans. The "frantic desire of the educated Africans is to develop Africanism" (witness Jomo Kenyatta, after seventeen years in Europe, now President of Kenya African Union and the Teachers' College).

There are still a few estates of 100,000 acres, much of which lies fallow. Real agriculture is carried on by farmers who cultivate small holdings intensively. A great majority of the 5,000,000 natives, during six months of the year, are half-starved, due to overpopulation (often 900 to the square mile), crop failure, drought, and a low water level. The native thinks the white man, not "the will of God," is responsible for his misery. To make the hungry native believe in the European's good intentions, Kenya must control erosion and overgrazing. For example, 49,000 Masai, with 700,000 cattle and several million sheep and goats, occupy only 15,000 square miles of land. Never do they kill cattle for food, but drink milk and blood extracted from the neck of the living beasts. These fiercely handsome Nilo-Hamites, renowned for intelligence, dignity, and great bravery, once dominated all of East Africa. A warrior capable today of taking singlehanded and without benefit of shield, a charging lion on his spear, is not easily convinced of the white man's superiority!

Nairobi is no longer the small peaceful town of twenty-odd years ago, when the roar of near-by lions shattered the midnight stillness of this reviewer's expedition base in Parklands where doors were never locked. Today among the "city's" 14,000 whites, 40,000 Indians, and 55,000 Africans on location, an "additional 22,000 African thieves and thugs, sleeping in warehouses, motor lorry bodies, etc. are an ugly problem."

Changed far less are the tribes of the Northern Frontier Province. The nomad Samburu still herd their flocks among giraffe, oryx, zebra, and gerenuk from shrinking rivers (wasted by farmers at the headwater) to water pans. Boran and Somali bring their camel caravans into Marsabit, the "Paradise Lake" of the Johnsons. There Farsen saw the foundation stones of the Johnson house, once belonging to the dwelling of G. F. Archer, the first white man to build at Marsabit, and the lake only a mud hole with storks digging for frogs. But elephant and greater koodoo still inhabit the cool uplands. Everywhere water is now drawn for man and beast from 70-foot ancient wells.

Farson pays high tribute to Gerald Reece, Provincial Commissioners of this heat-blasted region, and to the conserva-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tionists, Captains Archie Ritchie and Keith Caldwell, long-time wardens of the East African game and friends of countless Americans.

There is splendid description and thought-provoking fact in *Last Chance in Africa.* Anyone who knows this magic land will read Farson's book with appreciation and nostalgia and will be impressed by his effort to estimate correctly the complex relationship between the white man and the African in Kenya.

MARY L. JOBE AKELEY

THE REASONABLE LIFE

- - - - - - - - by Clifford Gessler

The John Day Co., $2.75, 214 pp.

THIRTEEN years ago Mr. Gessler published a charming account of his life on a remote Polynesian atoll in a book called *The Road My Body Goes.* From this same experience with native life he has now culled out another sheaf of recollections; this one, however, selected to illustrate the cultural factors producing "the reasonable life" led by the Napukans and designed to serve as an object lesson to the harassed, troubled, and neurotic members of our society. He describes in well-chosen examples of native behavior under various circumstances how the Napukans resolve their difficulties and manage their affairs. A clear-cut philosophy emerges from these anecdotes and recollections, and the reader is led to contrast the easy adjustment of the Polynesian to the exigencies of existence with the tenseness and maladjustment too frequently found among ourselves.

Mr. Gessler's sympathy with Polynesian life is profoundly evident, and his insight into its motivation is often remarkably acute. These give his book a warm and moving spirit that cannot help being ingratiating to the reader. This alone is enough to make the reading of *The Reasonable Life* a worth-while experience in plumbing a strange culture, even though Mr. Gessler's philosophical asides and value judgments may not be completely acceptable.

HARRY L. SHAPIRO

FISHING THE ATLANTIC

- - - - - by S. Kip Farrington, Jr.

Coward-McCann, $6.75
312 pp., 131 illusts.

IN *Fishing the Atlantic,* the author has produced a book that should be "required reading" for everyone interested in salt-water sports fishing. It is the work of an angling expert who also is a fine writer. The style is free-flowing and a considerable improvement over the author's previous books. The introduction, by Philip Wylie, is a masterly but deserved tribute to the writer.

Fishing the Atlantic is a most interesting and authoritative book on marine sports fishing which carries the reader smoothly from Nova Scotia down along the Atlantic coast in easy and informative stages to Florida, thence around the coast of the Gulf of Mexico to Alabama, Texas, and Mexico. There are chapters on Cuban fishing, Panama, Columbia, and Venezuela, on Bermuda and Jamaica, the Bahama Islands, Sweden, Denmark, France, and South Africa.

The book is profusely illustrated with reproductions of interesting photographs, and throughout the book the author imparts to the reader important information on boats, fishing accommodations, fishing methods, fishing tackle, baits, and lures. Every famous and near-famous angling area, offshore and on, is covered thoroughly so far as sports fishing is concerned, and every species of game fish for which these places are noted is described and commented upon in language every salt-water angler can understand.

ERL ROMAN

THE ADVENTURES OF MARCO POLO

- - - - Edited by Richard J. Walsh

The John Day Co.,
202 pp., 68 illusts.

IN the thirteenth century the Western world was slowly awakening from the Dark Ages. Ignorance of the Orient was so total that no one in Europe believed Marco Polo when he told the story of his travels throughout Asia. He had lived many years in China, during the short period of the Tartar domination. Marco, after his father and his uncle, had been a favorite of the Grand Khan Kublai, the great Mongol Emperor. In an official capacity, he had visited many strange countries. After his return to his native Venice, he was captured in war and jailed in Genoa, where he dictated the tale of his adventures. They sounded fantastic. Yet his account is certainly true in its essence.

Today, after many years of penetration and study of Asia, Marco's story can be better appreciated. Historians and geographers, of course, are particularly interested in his descriptions, but naturalists also find much to be learned from them. He never fails to mention the animals that he finds on his way. It is not always easy to identify them, and the accuracy of some of his statements may be questioned, as he often reports on hearsay. His accounts, however, teach us a great deal about the Asiatic fauna of his day. We are struck by the evidence of the tremendous and senseless

destruction since caused by man. In Kublai's empire, game was preserved for the selfish enjoyment of the ruler and his deputies, but nevertheless adequately protected, while falconry, hunting, and animal training had attained an unbelievable level of efficiency.

For those who, like the reviewer, have long traveled in Asia in complete safety and comparative comfort, Marco Polo's adventures, with all their slowness of transportation, dangers, and hardships of many kinds, take a special significance and win deep admiration. They also bring home the terrifying notion that, in our very days, Asia has suddenly become closed to Western man even more tightly than it was in the Middle Ages.

R. J. Walsh's adaptation makes the Adventures easy, pleasant reading, and C. Le R. Baldbridge's illustrations are evocative and beautiful. It is all the work of men who know and understand Asia.

J. D.

The Way to Game Abundance

- - - - - by Wallace Byron Grange

Charles Scribner's Sons, $6.00
365 pp.

THIS book is a manual of the causes of fluctuations in game populations and the practices to be adopted if the wide swings from peak to crash in these cycles are to be avoided.

Cycles in the abundance of animal life are too well established to be open to question. But there is plenty of argument as to what the fundamental causes may be. There is a periodicity to these rhythms which suggests a possible, perhaps a probable, relationship to sunspot cycles. The subject is an intriguing and important one because the forces at work on game may very well have a profound, although not so direct and obvious, influence upon human populations and man's behavior.

The author develops his thesis in an orderly manner, beginning with an analysis of the environmental background and proceeding to a discussion of plant and animal successions and the results of habitat changes. He then discusses the response of animal life to alteration of the plant environment, the nature of game cycles, and finally suggestions for the control of these cycles.

Many examples are given to demonstrate the various principles described. These are generally convincing and well chosen. Good half-tone illustrations also help to establish the thesis of the book. "The cycle, in truth, proves to be *the pattern of life* for earth's creatures.

"Climate and plants are its two great dominating forces—both terrestrial expressions of the fluctuant stars and heavens."

It is not possible within the limitations of this brief review to attempt comment on the author's philosophy. The subject is complex and has its moot aspects. Grange has, in my opinion, given a very plausible explanation both of the visible features of cycles and the invisible forces that cause them. His book is an important contribution to the literature on cycles and will be a valuable reference in the library of any nature lover.

Harold E. Anthony

A Roman Book on Precious Stones

- - - - - - - - - by Sydney H. Ball

Gemological Institute of America,
Los Angeles, Calif., $6.50
338 pp.

THE jeweler of today would be very happy to have gems now occupy the place in business and social prestige that they filled in Pliny's day. The best English translation of Pliny's famous book, that of Philemon Holland published in 1601, has long since outlived its usefulness as a guide to the "Naturall Historie of the World" and is little read today. Many will rejoice that Holland's old-fashioned phraseology has been simplified and clarified in this new gem book, assembled by Sidney Ball and edited by Kay Swindler.

The first third of the book presents a readable and fascinating picture of the source of gems, their uses, and their working in Pliny's day, the first century of our era. With numerous quotes from the Pliny text, it sums up the information imparted by Pliny in dribbles. The second third is a complete rewrite of Pliny's thirty-seventh book, printed on yellow paper to make it stand out and easy to locate. There are many marginal notes (infinitely preferable to footnotes, one might add) which give modern English equivalents for the gem names so far as Mr. Ball could determine them. The third section of the book is made up of notes on the numerous classic and historic references of the Pliny work. This section, too, is liberally embellished with marginal notes on the references to which Mr. Ball has gone for elucidation. A hasty glance will show that he read widely and to good purpose many authors seldom consulted today.

Sydney H. Ball was a very successful mining engineer, who was particularly well-known for his work in the African diamond deposits. His hobby was gems, particularly diamond data, and for years he wrote the gem section of the *Minerals Yearbook* of the U. S. Bureau of Mines. One may feel sure that the translations of Pliny's names, for which a degree of certainty has been indicated, are as close to the correct ones as we shall ever come. The editor, Miss Kay Swindler, deserves special commendation for the fine appearance of the book, the marginal notes, and the facsimile reproductions, as well as for the unusually extensive work with the text, which fell upon her as a result of Mr. Ball's death last spring. The publishers are also to be commended for their courage in printing such a fine but perhaps commercially venturesome book.

F. H. Pough

Caste, Class and Race

- - - - - by Oliver Cromwell Cox

Doubleday & Co., Inc., $7.50
624 pp.

RACE conflict is one of the most disturbing problems facing the people of this country. Without a satisfactory solution to this unhappy situation, the tensions that mark race relations hover over us as a constant threat. They ramify throughout the social structure and decay its bonds. As long as we continue to ignore them, we weaken our moral strength as a people and endanger our leadership in the world.

Americans throughout their history have been aware of the dangers of racial stresses, particularly those latent in Negro-White relationships. There has never been a period from the founding of the Republic when the injustices of the Negro position in our society have not exercised some of our most thoughtful public men. And despite the outbreak of violence in the form of a civil war, which in part concerned the moral issues of slavery, the problem has persisted unresolved.

Mr. Cox in *Caste, Class and Race* has examined once again the position of the Negro in American society. He brings to the task a considerable apparatus of scholarship, a forthright and uncompromising intellectual position, and a vigor that demands attention. He rejects the assumption that the Negro has become frozen within a caste system and argues that his exploitation is rooted in the capitalist structure of American society. He is convinced that only by a socialist revolution will conditions prevail favorable to a final solution of this ancient and troublesome disharmony.

Despite the air of polemics that tinges the book, it has much to say that is worth considering carefully. And even if one cannot agree entirely with the author, he should be read, for he represents a point of view that has a number of supporters.

Harry L. Shapiro

THE ALMOST identical form of these two temple pyramids from tenth-century Cambodia (*left*) and from the Maya culture of about the sixth century is indeed striking. Students who support the theory of cultural exchange between Asia and America point out similarities of detail, including the use of the co vault, serpent balustrades, serpent columns, and attached c in panels. Opponents of the theory point out the many diff in the architecture of southeastern Asia and Middle A

Is American Indian Cultu

Most anthropologists believe that the high civilizations of Middle and South America developed without influence from abroad. A recent exhibit at the American Museum shows, however, why some scholars think there may have been traffic across the Pacific in the days before the Europeans discovered America

By GORDON F. EKHOLM

Associate Curator of Anthropology, American Museum of Natural History

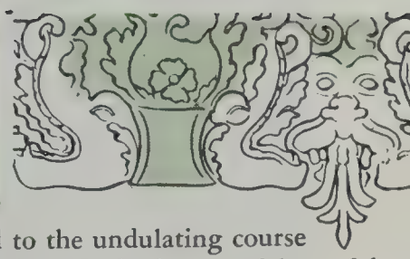
DID the American Indian civilizations develop independently, or did they receive some inspiration or stimulation from the high cultures of the Old World? This is perhaps *the* most important question confronting those working in the field of American archaeology and seeking to make known the true history of the American Indian. It is also a question of outstanding significance to our general understanding of how civilizations come into being, of how simple and primitive cultures develop into more complex ones.

Anthropologists are in fair agreement that the New World populations—in a physical sense—belong to the Mongoloid racial stock and that they originally came out of Asia across the Bering Straits during or shortly after the last glacial period. We can imagine these early migrants and the other following groups pushing southward into warmer climates and gradually spreading out over the humanly empty areas of North and South America. They must have been

Decorative Motifs

Amarāvati. Southern India

Ceylon



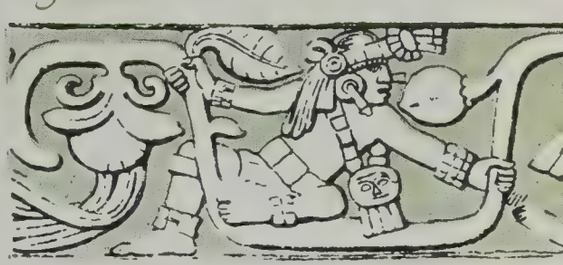
THE SCULPTURED PANELS above and below have enough elements in common to suggest historical relationship. The designs are based on the lotus plant, with the leaves and flowers accommodated to the undulating course taken by the stem of the plant. In both cases fish or fish-like creatures are placed at the ends of the patterns, and very similar jawless monster masks are used at the centers

Yucatán

Amarāvati. Southern India

THESE PORTIONS of the same series of panels show human figures holding on to the stem of the lotus plant in a very similar way. Costumes and details are different, but the nearly identical arrangement of the figures strongly suggests a common tradition

Yucatán

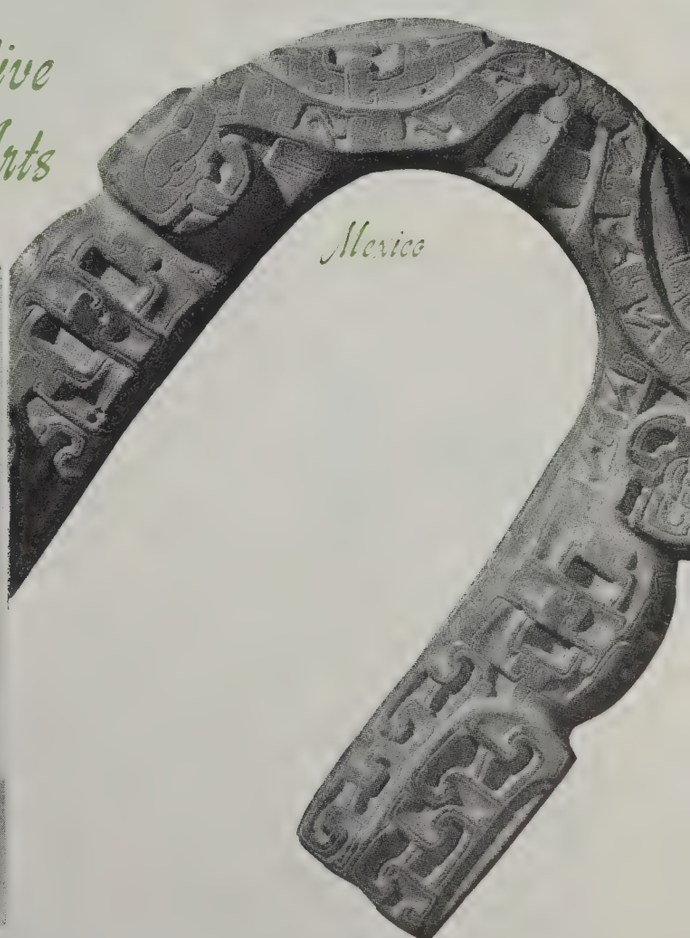


Asiatic?

Decorative Arts

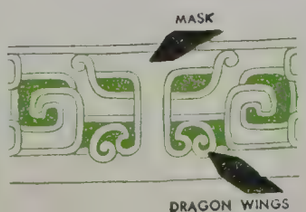
China

Mexico



China

Mexico



STRIKING SIMILARITIES in design patterns are found in the Late Chou style of China and in the so-called Tajín style of Vera Cruz, Mexico. You will see in both a similar emphasis on interlaced bands in horizontal and vertical arrangement, with rounded corners. Masks or dragon-like figures are incorporated in both. Note also that both examples show the double outline and the identical use of what are known in Chinese art as dragon wings

THIS BRONZE VESSEL from ancient China and the so-called palmate stone from Mexico have the interlaced pattern mentioned before, but in a modified form. The whorls are more tightly wound, and they spiral out from the surface. Particularly the upper portion of the palmate stone shows this similarity

equipped with a simple hunting and gathering type of culture adapted to the subarctic climates of northeastern Asia and Alaska. This is a logical assumption, and it is supported by all the archaeological evidence of early man in the New World. Agriculture, which appears to be a basic necessity for a high civilization, could hardly have been brought to the New World by this route.

Assuming then, as it appears we must, that these early populations of North and South America were culturally quite simple, we must explain how they proceeded along the road toward civilization and ultimately produced such things as the magnificent Maya temples of Central America and the detailed and efficient governmental system maintained by the Inca in the Andean regions of South America.

The importance of our questioning becomes more apparent if we examine the history of the early development of civilization in the Old World — in the Near East, Egypt, Europe, India, and China. The more we learn of these great cultural centers, the less it appears that they were separate civilizational developments. They all seem to have sprung from one cultural development occurring somewhere in the Near East, and their growth involved a certain amount of cultural interaction. Thus, despite their differences, they can be considered as one great cultural development.

Are the higher civilizations of America the world's only exception, the one other example of this all-important rise from a stage of primitive culture to the complex form known as civilization? If they are an exception, there have been two isolated occurrences of civilizational growth in the history of human culture, and we come as close as we ever will to having a kind of laboratory check on how civilizations, as great units of cultural development, originate and grow. This would obviously be of extreme importance to all theoretical considerations of human history. If, on the other hand, the birth of the American civilizations can be traced back to influences coming out of eastern Asia, it is something we must know if we are to evaluate correctly the history of human culture.

To phrase the question in more concrete terms: Are certain cultural forms inevitable in the growth of civilization? Given enough time, would any large group of people living in a suitable environment rise

from a hunting-gathering existence to one based on agriculture? In both southeast Asia and the Amazon area, blowguns are used with poisoned darts for the hunting of small game, and they are remarkably similar in constructional details and in decoration. Was the blowgun invented independently in those two areas, because of the existence of similar environmental conditions and the presence of suitable materials? Is the form in which one makes a stone club so much governed by its intended use that such specialized types as the star-shaped or "pineapple" clubs found in Melanesia and America would be invented again and again?

This problem of whether or not the American Indian cultures were influenced by those of the Old World has been argued since the time when Europeans first came to know the American Indian in the fifteenth and sixteenth centuries. As we shall see later, it is a problem difficult to prove definitely one way or the other. It is a field in which quite opposite opinions are sometimes held by persons equally well informed.

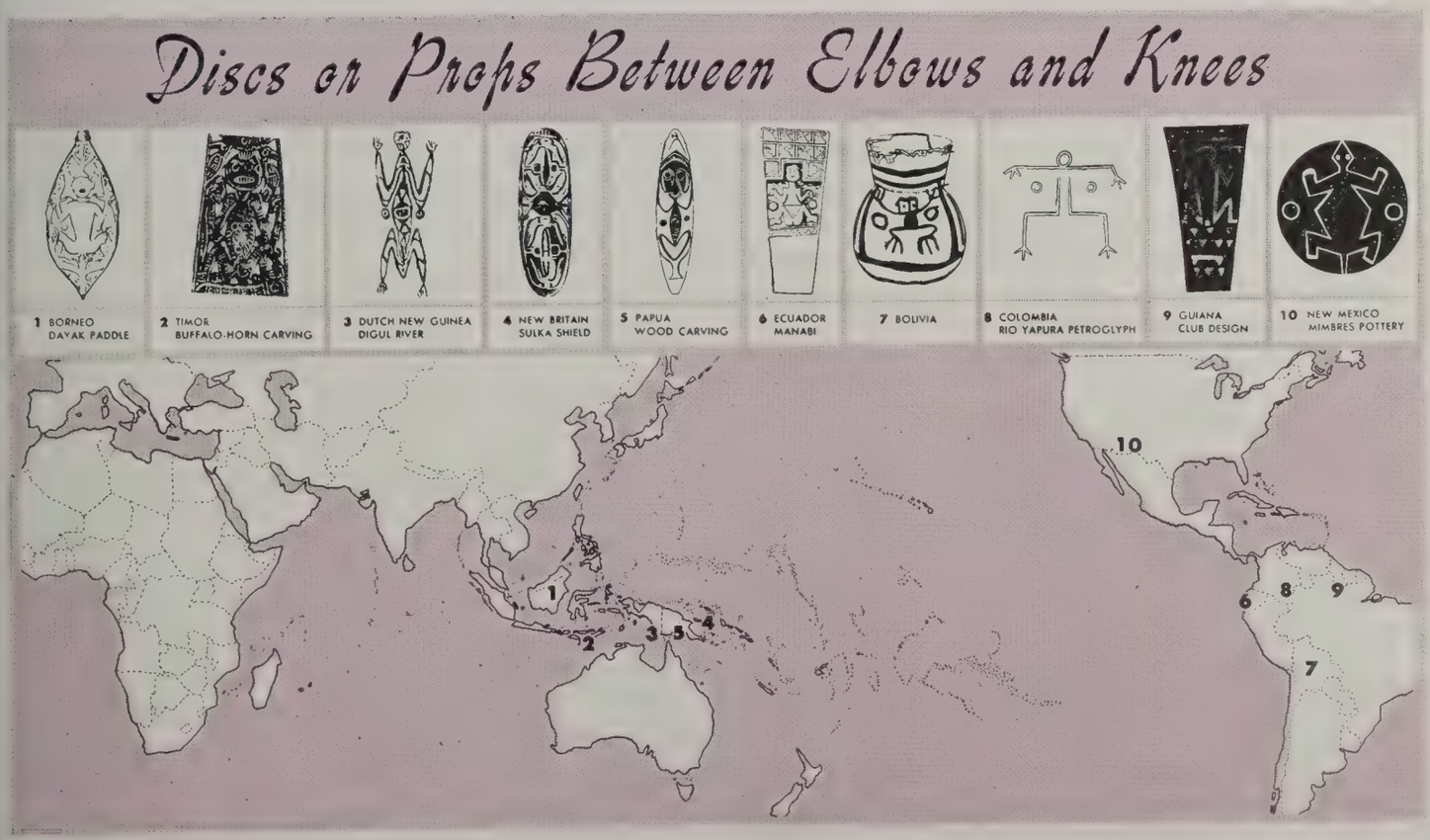
On the one hand, there are those who have been labeled *independent inventionists* — those who believe that the American Indian civilizations evolved by themselves in the New World without benefit of cultural promptings from the Old. This side of the argument has been upheld for the last three decades or

Brazil

SIMILARITY OF DECORATION is shown in this bronze drum from the Shang period of ancient China and a jar from eastern Brazil. Grotesque arms, legs, and horns —stylized in the same way and superimposed upon a decorated background— characterize both pieces and hint at a common artistic tradition, though the regions are many thousands of miles apart

▼ ON BOTH SIDES of the Pacific discs or props are inserted between the elbows and the knees in conventionalized drawings of the human figure. The examples shown are a few out of the many that have been noted

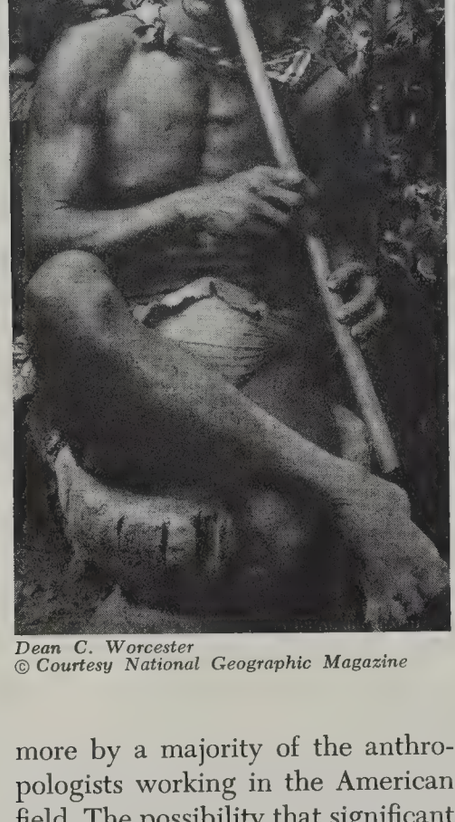
From exhibit prepared by Dr. Carl Schuster



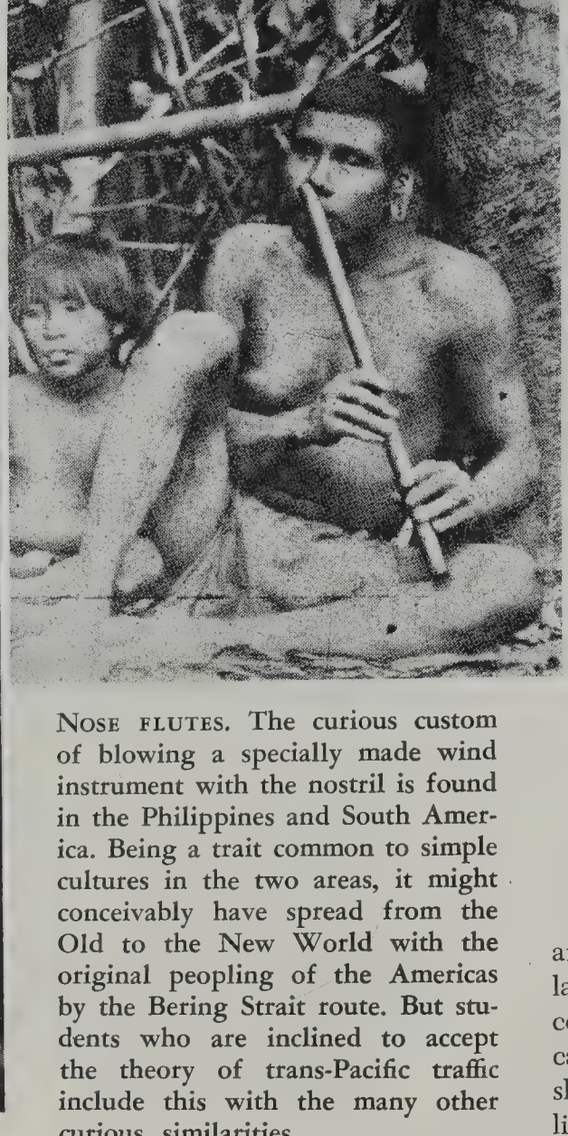
Music

South America

Philippines

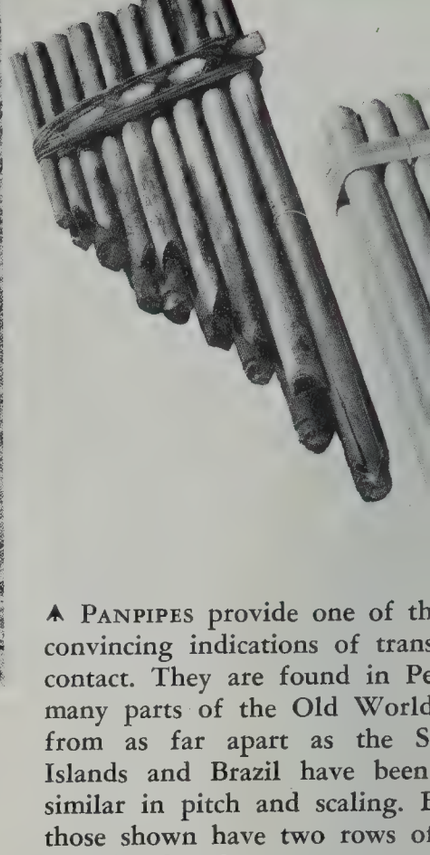


Dean C. Worcester
© Courtesy National Geographic Magazine



NOSE FLUTES. The curious custom of blowing a specially made wind instrument with the nostril is found in the Philippines and South America. Being a trait common to simple cultures in the two areas, it might conceivably have spread from the Old to the New World with the original peopling of the Americas by the Bering Strait route. But students who are inclined to accept the theory of trans-Pacific traffic include this with the many other curious similarities

Solomon



▲ PANPIPES provide one of th convincing indications of trans contact. They are found in Pe many parts of the Old World from as far apart as the S Islands and Brazil have been similar in pitch and scaling. E those shown have two rows of one closed and one open

more by a majority of the anthropologists working in the American field. The possibility that significant trans-Pacific contacts may have occurred has been almost totally discounted, and those who study anthropology in the United States are strongly indoctrinated with this point of view.

In contrast to those who would view the American civilizations as an independent growth are the so-called *diffusionists.* These would minimize the likelihood that the same things could have been invented more than once, and would explain the cultural parallels in the Western and Eastern Hemispheres as a result of historical contact. In recent years adherents to this point of view have not been numerous among professional anthropologists. Furthermore, among those who have espoused the cause and have thus flouted "authority," there are some who have seemed to find it necessary to take an extreme point of view, insisting that every cultural trait of any significance in the New World, if it appears similar in any degree to one in the Old, must have come by diffusion from the Old World. This has tended to weaken the argument rather than to strengthen it.

With an interest in bringing this problem more into the open and to stimulate serious discussion of it, the Department of Anthropology of the American Museum recently presented a special exhibit, which asked, in a visual manner, some significant questions about the possibility of Old World influences on the American Indian cultures. It was especially prepared for a meeting of the International Congress of Americanists being held at the Museum and was thus seen by an unusually large number of specialists concerned with the problems of American Indian origins. The interest shown by these experts and the lively debates that ensued were sufficient proof that our exhibit was dealing with an important problem

The exhibit showed, side by side objects and photographs of various things from Asia and Oceania on the one hand and America on the other pointing out similarities that might be thought to indicate cultural relationships between the two areas. It asked the question: What do these parallels in the two areas mean? We do the same in a more limited way in the illustrations accompanying this article.

In attempting to trace historical relationships through the study of customs and material objects when no written records are available some things must be considered more significant than others. It might reasonably be argued, for instance, that because of the limited number of possible ways that could be used to decorate woven textiles the use of tie-dying might be invented again and again and its oc

...extile Industry

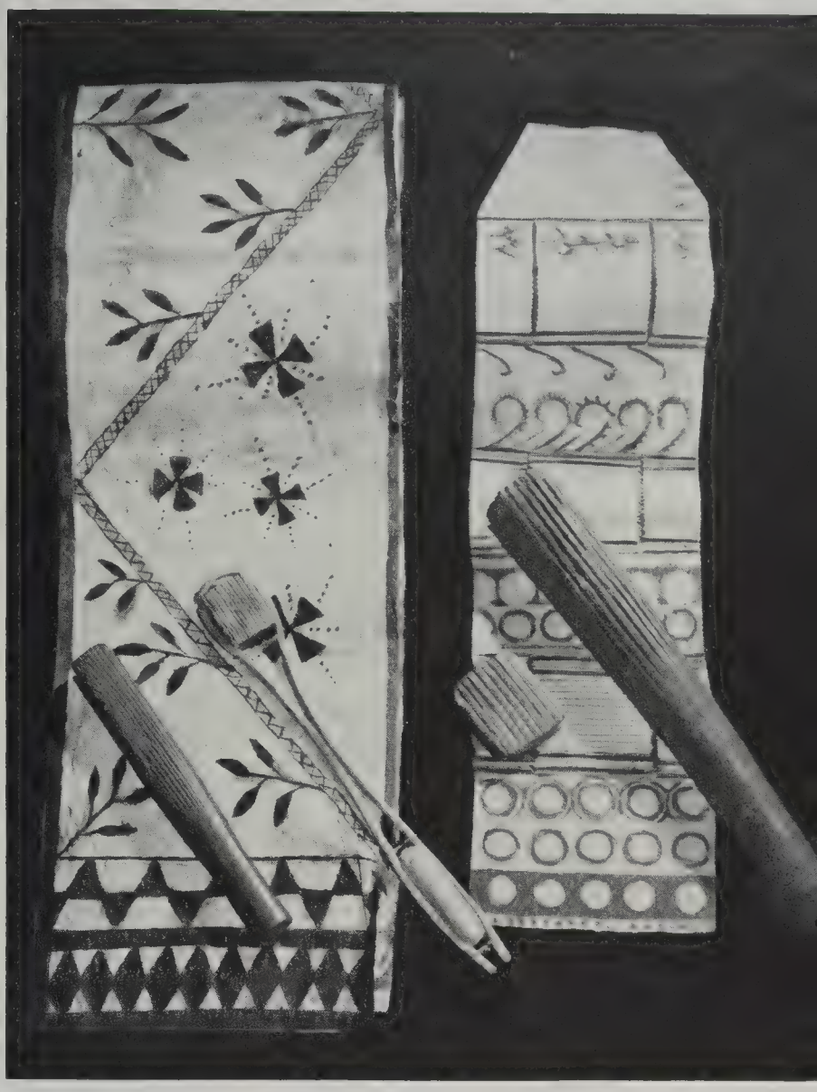
Philippines

N BOTH the Old and New World, the simple two-bar back-rap loom has several basic features in common, including ...e use of shed rods, heddles, and battens. Tie dyeing is ...mmon to southeast Asia and America, and so is the spe-...alized decorative technique called *ikat*—a method wherein ...e yarn is dyed in such a way that a design will come out ...hen the cloth is woven

Mexico

Bark Cloth Manufacture

Oceania *Middle America*



▲ THE METHOD of manufacture and the implements used are common to the Pacific area and tropical America. Outstandingly similar are the rectangular stone beaters from the Celebes and from Mexico, with corrugations on both sides and grooves around the edges for hafting. Are these identical tools and techniques the result of the same functional adaptations, or is historical relationship implied?

currence in two areas would not be an indication of historical relationship. But there is not the same limitation of possibility when it comes to decorative design. The possible combinations in naturalistic and geometric motifs make it exceedingly unlikely that the same combination will be invented repeatedly by groups having no contact. With this in mind, it is interesting to consider what we call the lotus motif as used in Buddhist art in India and southeast Asia and in certain Maya sculptures at Chichen Itzá in Yucatán. Because of a lack of space, full illustration of the comparable material cannot be given here, but the drawings we have included on page 345 may be sufficient to indicate some of the points of similarity.

In both areas the lotus plant has been used as the principal motif in the border portions of large relief-sculptured panels. In both cases the lotus plant has been given an undulating, creeper-like shape not corresponding to nature, and the buds, leaves, and full flowers are arranged within the pattern. Human figures are interspersed, holding on to the rhizome of the lotus plant in very much the same way, and fish or fishlike monsters are used at both ends of the panels. There are instances in both areas of the lotus emerging from the mouths of jawless monsters. Could this complex of motifs have been invented, or rather could it have evolved separately in the two areas without any contact between? To my mind it appears more probable that these similarities resulted from some historical contact between the two areas.

If these two occurrences of the lotus motif look sufficiently similar to stimulate one's interest in possible

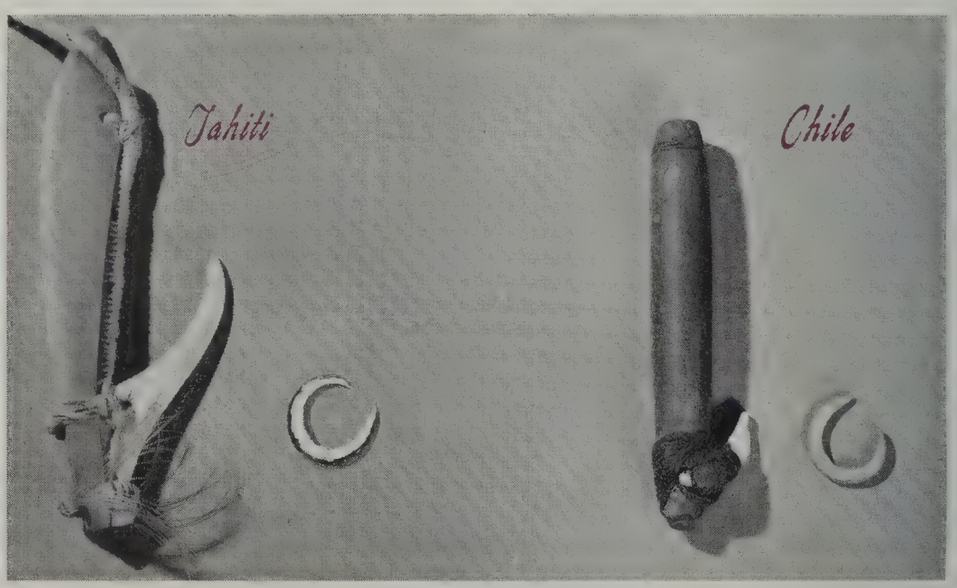
Books

◀ SIMILAR METHODS of bookmaking are shown in these two examples from Mexico and Sumatra. They are made of a continuous strip of material, used on both sides and mounted between board covers. Both are made of specially prepared bark; both are, in part at least, books of divination

historical affiliations, let us look further for other similarities between the Buddhist art of India and southeast Asia and Maya art. In both areas a common religious-artistic conception portrays a dragon-like monster with wide-open jaws and with a human face or figure in the mouth. There is also the well-known "cross" at the Maya site of Palenque, having the form of a stylized tree with a grotesque face in its branches. This is markedly similar to the representation of the celestial tree on top of the cosmic mountain in the shadow-play figures of Java —a motif of considerable antiquity in southeast Asia. There are a number of other comparable motifs in the two areas, including the use of serpent balustrades, Atlantean figures, and gods or ceremonial figures standing on the backs of crouched

Implements

THE DISTRIBUTION of certain forms of fishhooks provides striking evidence of possible communication across the broader reaches of the Pacific. These beautifully made stone fishhooks from Easter Island and California could hardly be more alike



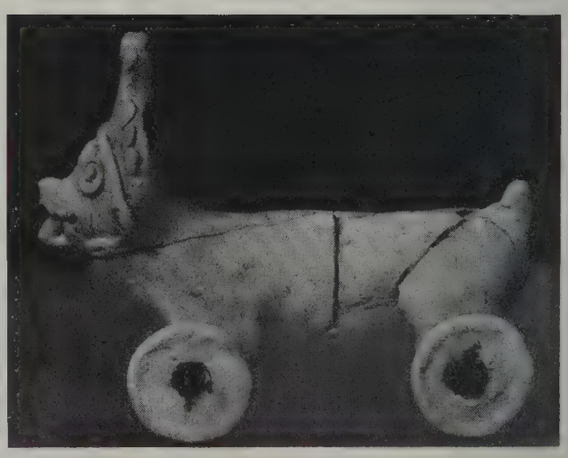
▲ EVEN MORE SIGNIFICANT than the identical stone hooks are two other types found in combination on many islands of the Pacific and archaeologically in coastal Chile. In both regions, the larger composite hook is made of shell, bone, or stone, and the smaller one of shell

Wheeled Toys

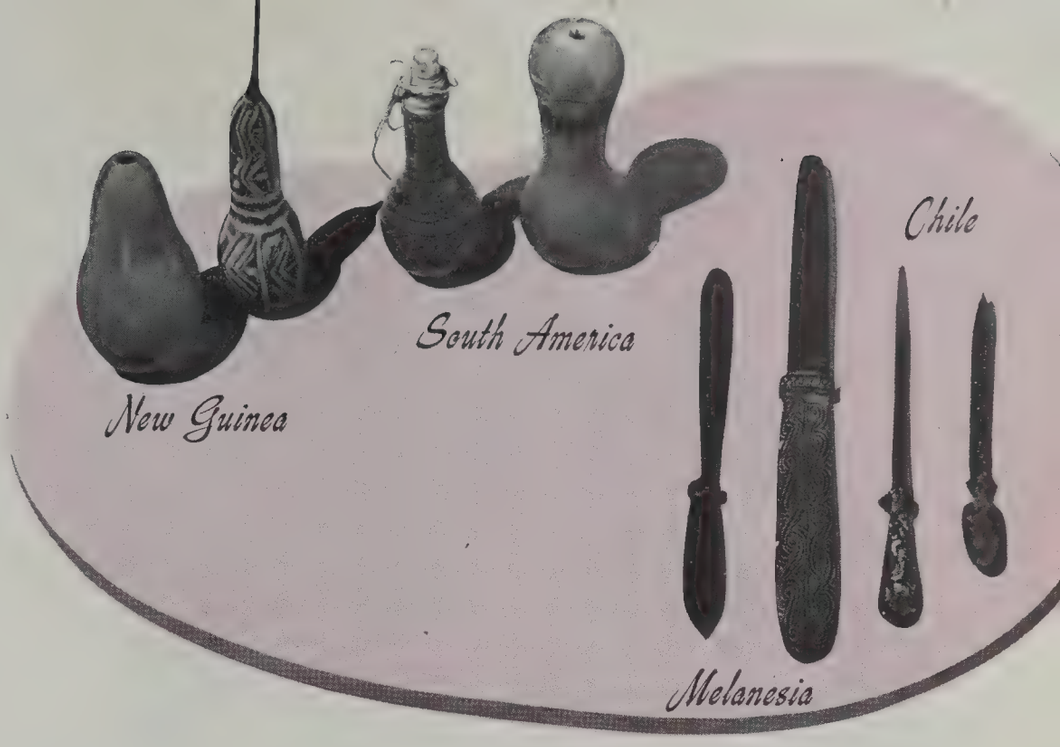
India

Mexico

THE FINDING of wheeled toys made of clay in Mexico (*right*) shows that the principle of the wheel was understood by the Mexican Indians before the time of Columbus, even though wheeled vehicles were apparently not used in transport in the New World. Similar miniatures in bronze, sometimes representing gods, were also used in China and India (*left*)



Betel and Coca



▸ BETEL-CHEWING in southeast Asia and Melanesia has much in common with coca-chewing in the Andean region. In both localities lime is added to release the alkaloid. Certain accessories used show remarkable parallels, as seen in this photograph. Lime containers in both regions are frequently made of gourds of the same species. Two wooden spatulae from Chile are very much like their Melanesian counterparts.

human figures. One of the most striking parallels, however, is that seen in the game of pachisi as played in India and southeast Asia and of the game of patolli as played by the Aztec. In these two games there are a number of quite specifically similar features that make it exceedingly unlikely that they developed independently.

The parallels we have mentioned so far are probably more significant than many of the others shown in the illustrations because they represent a complex of traits that belong to specific cultural traditions and specific periods in both Asia and America — the Buddhist dominated cultures of India and southeast Asia of from the second to the twelfth centuries and the Maya-Mexican cultures of the New World running from approximately A.D. 500 to 1200. In regard to these, we are not subject to the criticism often directed toward those who have attempted to link the Old and New World cultures—that scattered traits from here and there have been compared and no logical scheme of possible relationship has been given. In showing a number of similarities to exist between Buddhist art and Maya-Mexican art, we have outlined a specific area of study that can be attacked and discussed in a scientific way.

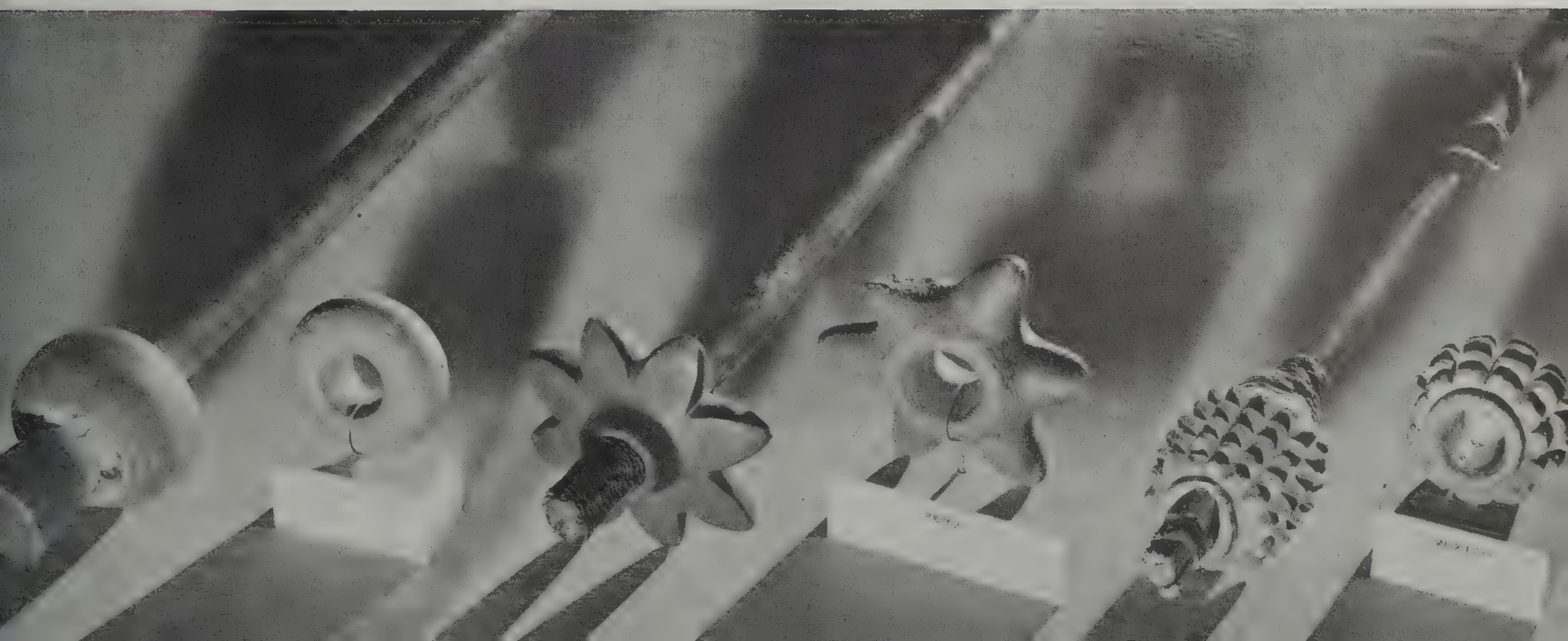
The whole problem of Old and New World relationships is, of course, so complex that we cannot begin to discuss it in any detail in a short article. We must mention, however, that recent studies of American cultivated plants have suggested the possibility that maize, or corn, the basic American food plant, may have been cultivated in upper India and Burma before the time of Columbus and transported in one direction or the other across the Pacific.

If we feel that these parallels between the civilizations of the Old and New Worlds indicate historical relationship, we find ourselves faced with the not inconsiderable problem of explaining how contacts between the two areas came about. What sort of contacts could have taken place across the very broad reaches of the Pacific? It is largely the difficulties involved in finding an answer

Continued on page 382

eapons

▾ STRIKING LIKENESSES are seen in the stone tools of Asia and Oceania on the one hand and the Americas on the other. The clubs with handles are from Melanesia, in the southwest Pacific; those without are from Peru and Mexico. Diffusionists argue that nearly identical forms like these could scarcely have evolved independently. Their opponents invoke the long arm of coincidence and point out the many *dis*similarities between the oriental and American Indian cultures



Meet Australia's bobuck—a rare and remarkable animal whose splendid pelt is its worst enemy

POSSUM of the HIGH RANGES

By DAVID FLEAY*

All photographs by the author

▲ "CAN'T I EAT IN PEACE?" this bobuck seems to remark as it strikes a characteristic pose. In its forepaws it holds a delicacy, which it chews happily despite the daylight

IN the dense mountain timber fringing eastern Australia from south Queensland to southern Victoria lives the mainland's largest, most powerful, and finest possum. It is, in fact, the equal of the famous long-furred Tasmanian "Black." Usually referred to as the short-eared possum—an obvious distinction from the rather fox-faced silver-gray or brush-tail possum—this black-footed marsupial is also known by the aliases of mountain and dog-eared possum.

It is a remarkable, distinctive, and very alert animal, noted for a peculiarly rank and musky odor that is almost as easily detected in the bush as the powerful scent of fox. In the region of Gippsland in eastern Victoria this magnificently coated species (*Trichosurus caninus*) has the nickname of "bobuck"; and wearing the most prized of pelts it became, in open seasons, the trapper's most sought-after quarry. Sad to say, this striking marsupial took the brunt of destruction in the dreadful sweep of the 1939 bush fires, and only recently have I seen odd individuals in regrown

*DAVID H. FLEAY, an expert on the fauna of his native Australia, has approached his specialty from every angle: research, teaching, writing, and field work. He was the designer, builder, and curator of the Australian Section of the Melbourne Zoo and later director of the Sir Colin Mackenzie Fauna Sanctuary. In 1941, he was awarded the Australian Natural History Medallion.

Mr. Fleay is the only man who has succeeded in breeding the platypus in captivity; and it was he who captured, conditioned, and transported Cecil and Penelope, the platypus couple, to the New York Zoological Society in 1947. He is the author of two books, *We Breed the Platypus* and *Gliders of the Gum Trees,* and is a Council Member of the Royal Zoological and Acclimatization Society of Victoria. He has contributed to a number of periodicals.—ED.

areas that were formerly their strongholds.

Typically a slow breeder and a creature of peculiar surroundings, this mammal has been unable to adapt itself to the great variety of foods and environments enjoyed by the common silver-gray (*T. vulpecula*). The bobuck is a mountain fellow and is essentially at home in the elevated, high-rainfall regions of mountain ash (*Eucalyptus regnans* and *E. gigantea*), beech, hazel, sassafras, dogwood, musk, and tree fern. This big possum, with its extremely bushy and almost wholly black tail, is usually dark gray in color. But from the scrubs of northern New South Wales and southern Queensland, a truly black race has been described, and odd velvety-black individuals have also revealed themselves in the Healesville-Warburton ranges.

By night the big fellows wander the gullies, spending practically the whole of their time on the ground feeding upon succulent shoots and young leaves, fern fronds, flowers, and fruits. Following faint trails, they bound along handy bridgeways of huge fallen trees that span crushed and impenetrable masses of tangled vegetation. Seldom, indeed, does the bobuck ramble to a great extent in the trees, though it readily scampers aloft when danger threatens. The large sturdy feet are obviously more those of a ground wanderer than are the comparatively slender ones of its relative, the silver-gray. However, when actually treed by the sight or scent of intruders, the bobuck trumpets defiance in a series of loud and rapid staccato grunts that are quite unlike any other bush sound. Entirely distinct from the blare and chuckle of the silver-gray, this call is unmistakably characteristic of this species alone. At close quarters, the animals not only utter defiant grunts but raise themselves to full height with arms drawn back in sparring position ready to strike, at the same time adding "circular saw" screams for good measure. This is by no means pure bluff; incautious handling of the animal proves it a formidable antagonist, equally handy with its ripping claws and biting teeth. W. A. Wheelwright, the old bushman-author-game shooter of the 1850's, recorded very graphically the possum's habit of escaping the reach of an enemy, "... at which it will sit swearing after the manner of a cat."

In hours of darkness, the bobuck's forthright call may be heard occasionally from an enclosure in Healesville Sanctuary, where a fine eleven-pound specimen, originally bred there, now has a snug home in a hollow log. Recently, while spending some days and nights in the bush investigating lyrebirds, pleasant memories of other days were recalled when the insistent trumpeting of a wild bobuck in a near-by mountain ash proclaimed its dislike

▲ TWO JOEYS of different species: short-eared possum (*left*) and silvery-gray possum (*right*). Both are four and a half months old, but notice the difference in size

▼ A FOUR-WEEK-OLD POSSUM, naked and helpless, fumbles outside the mother's pouch. It is still strongly attached to the mammary gland. It does not become independent of the parent until it is six months old

▲ A MOUNTAIN POSSUM CARRIES her four-and-a-half-month-old joey on her back. The Mountain Possum is the largest and most powerful member of the possum family on the Australian mainland

of our hurricane lamplight. Sad memories were also recalled, for it was along the Acheron River in late 1938 that we undertook to capture the original mountain possums that graced the Sanctuary for so many years. Here Harry Kerslake and his wife and daughter watched the traps until success attended their efforts. When the great fire of '39 overwhelmed that beautiful valley and most of its fauna, it was the Kerslakes who so tragically perished in their ill-fated dash down the Acheron Way.

In past open seasons the mountain possum has been hunted unrelentingly for its thick and beautiful pelt. One of the natural baits used to attract the animals into snares and "figure-of-four" traps is a portion of the crown of a split tree-fern trunk—an irresistible delicacy to mountain possums. Unfortunately, the animal is not a rapid and hardy breeder, and in many mountain districts former trapping operations, plus the ravages of the all-devouring bush fire, have made the species extremely rare. In the event of a declaration of open season for possums in the future, it is earnestly to be hoped that the short-eared species will remain totally protected.

Though retiring and nervous in disposition, the bobuck has an appetite for delicacies that soon conquers its timidity. One night in a gully in the Dandenong Ranges the crackling of sticks among the damp tangle of blanket wood, sassafras, wattle, and hazel betrayed the movements of one of these big possums. I trailed it, but it suspiciously ran up a sapling and perched on a limb about seven feet from the ground. Leaping up, I seized the tip of its great bushy tail and brought the animal down. The bush rang with its ear-splitting shrieks; but less than four minutes later the same disheveled marsupial was squatting in a box, still snorting defiance but at the same time devouring a ripe pear with great relish and noisy chewing.

In Victoria the short-eared possum gives birth to a single joey either in May or June, but away from native foods it is not easy to induce the species to breed in captivity. The pouch of the female contains two mammae, but unlike the silver-gray, which occasionally rears twins, there are no records of more than a single youngster occupying the pouch at a time. Before the birth, the female constantly examines and licks out her pouch, and as soon as her pink, ugly mite arrives (only three-eighths of an inch long at birth!), it instinctively works its way into the pouch. In the case of the silver-gray possum, I have taken newborn young out of the pouch and have watched them re-perform this wonderful feat.

At birth the infant is not only minute but blind, with stunted, undeveloped limbs. For six weeks, it is firmly attached in the pouch, gradually developing power to move its own small jaws. It is most interesting to watch the mother's antics at night, as she pauses in her ambling walks to sit up on her haunches, relax the muscular, ring-

like pouch-opening, and, holding it agape with handlike forepaws, thoroughly cleanse the small occupant with her tongue. At the age of about ten weeks, short fur appears first on the head and with time gradually spreads to the shoulders and lower body. At four months the young one, now about guinea-pig size, forsakes the pouch and rides at night on its mother's back, clinging tenaciously with claws and teeth. For some weeks longer, it continues to draw nourishment from within the pouch but also chews tender shoots that come within its reach.

If separated from its mother for even the briefest time, the joey soon attracts her attention with an urgent series of quavering, husky cries. "Roger," a baby mountain possum born and reared in my collection, usually rode on Ma's back to the food basin in the evening but always conveniently slid over her head to the honey, jam, and bread when she reached her destination. Not until it is six months old does the short-eared possum become independent of its faithful parent.

Present on the chest of mountain possums, as on the silver-gray, is a longitudinal streak of rust-colored fur in the otherwise creamy-white "vest." This is a glandular area; and, remarkable to relate, massage of the chest of one species of kangaroo has been known to produce a reddish pigment. Mountain possums, however, are in the habit of rubbing this area on convenient boughs, performing quite a ritual in the process. The next short-eared fellow to come along scents the spot, and with the obvious attitude of "So-and-So has passed this way," he, too, rubs his chest on the limb or bough. So much for self-expression among the nocturnal denizens of the big timber!

Though home trees of the species may usually be detected by the deep scoring of the bark, torn from the ground up by constant passage of strong claws, the animals do not always sleep aloft. They frequently camp in cavities created by termites and by rot inside great fallen logs. No attempt is made to line the resting place with materials of any kind; the animal simply squats, rolled up, on the bare wood. The musky odor, particularly strong in the "old men," is usually sufficient to determine whether the tenant of a hollow is at home.

Spring, summer, autumn, and cold winter sojourns in mountain country on the trail of rare marsupials have brought us a variety of contacts, accidental and otherwise, with short-eared possums. Far up the slopes of Mt. Wills, northeastern Victoria, a trumpeting overhead awakened us at 2 A. M. one black night, and the spotlight beam revealed the blazing red orbs of a huge, thick-furred fellow perched on a thin sapling. Two strokes of the ax and he was down in a wild scatter of provisions and equipment. The ensuing chase flashed through and around camp, up and down blanket wood and dogwood bushes, until eventually "possie," minus patches of easily lost fur, was escorted back under guard, as breathless (though not as cheerful) as the gang that celebrated by "putting the billy on." I have met and carried several bobucks for miles out of the bush at Upper Beaconsfield, Bendock, Mt. Cole, Bonang, Korweingeboora, the Snowy River country, and nearer home at Healesville. I recall mountain possum in the brightness of morning daylight gazing reproachfully at us as they sat tethered in snares set for other game.

Perhaps the greatest anticlimax to an otherwise easy capture occurred on the Black Spur roadside one midnight in the 1930's. A bobuck had scampered off the road and bolted up a young ash; and as I followed, weakening fast and mighty breathless, up the branchless 20-foot trunk, that usually very thoughtful lady, my wife, suddenly emerged from the car shrieking, "Not in those good trousers!" Laughter was fatal, and I fell down helpless. What a time to tackle a man about the relatively unimportant subject of clothes!

SETTING A SNARE in a deep tree-fern gully in mountain-possum country. The ee ferns range from one to forty feet in height. At this spot a stream dives venty feet below the surface and emerges farther down. The bobuck thrives only elevated, forest regions such as this

A five-year-old boy was murdered on March 27 in Sarasota, Florida. Perhaps "murder" is not the right word, for Edward Schooley was killed by a circus elephant. "Dolly" had been one of the most docile members of the Ringling Brothers, Barnum and Bailey elephant herd for more than twenty years. But for some inexplicable reason she suddenly turned vicious and trampled to death the child who was offering her a peanut. The president of the circus publicly announced that Dolly would be destroyed, and this was done within three days after the tragedy.

According to radio reports, circus officials received many letters and telegrams from people all over the country complaining that Dolly's execution was unjustified. They apparently felt that a moral issue was involved and that an animal could not be held responsible for its actions. This point of view implies some interesting assumptions concerning animal psychology, but one thing is quite clear. If such an event had happened one or two centuries ago, the animal involved would have received quite different treatment. The law today states merely that dangerous or vicious animals must be destroyed. This represents a fairly recent simplification of older legal codes.

Ancient Hebraic law decreed that the goring ox be stoned to death. Plato's "Laws" directed that if any animal killed a man, except in combat authorized by the State, the nearest kinsman of the victim should prosecute the murderer. The case was tried by a public official, and if the verdict was against the accused, the guilty animal was banished from Greece. Citizens of Rome used to celebrate the anniversary of the preservation of the capitol from night attack by the Gauls. On this occasion homage was paid to descendants of the sacred geese whose cries had given warning of the enemy's approach. On the same day a dog was crucified for the failure of its forefathers to give the alarm.

During the Middle Ages the practice of trying and condemning animals was common in Europe and the British Isles and later even in the New World. It was not confined to small villages and backward regions. In 1546 the French Parliament, the highest court in the land, ordered the execution of a cow, which was first hanged and then burned at the stake. Similar legal trials survived until fairly recent times. In 1906 in a small Swiss village a man and his son, accompanied by their dog, robbed a householder, and in the course of the crime the victim was killed. The two men were sentenced to life terms; but the dog was condemned to death because, the court decreed, it was the chief culprit, without whose complicity the crime would have been impossible.

Between A.D. 824 and 1845, there were at least 144 formal prosecutions resulting in the execution or excommunication of animal criminals. When a domesticated animal injured or killed a human being, it was formally arrested and thrown into jail. Then the judge or ruling nobleman of the district appointed one or several attorneys, who were charged with the duty of defending the accused. Public prosecutors and defense lawyers argued each case before the bar, and the evidence was weighed carefully by the judge before he rendered his verdict.

Mass indictments were not uncommon. On September 5, 1379, the village swineherd of Saint-Marcelle-Jenssey left the communal herd in the care of his son. Before his father was out of sight, the boy began to tease some nursling piglets, which promptly burst into

Beas

▼ THE HIGHEST FRENCH COURT tried a cow in 1546. On the assumption that animals possessed a moral sense, capital punishment was the verdict

a cacophony of terrified squeals. Three old sows charged the tormentor, knocked him to the ground, and killed him before his father could intervene. All the pigs were hurried off to jail, and after due process of law, Philip the Bold, Duke of Burgundy, condemned the three murderers to death. Their guilt was so plain that no one protested the decision, but the legal position of the remaining animals was less clear. The prosecutor insisted that they should be punished as accomplices. He called several witnesses, who testified that all of the swine had hastened to the scene of the murder and shown by their gruntings and aggressive actions that they thoroughly approved of the assault. A wholesale execution was narrowly averted when the attorney for the defense pointed out that the punishment of the convicted pigs would doubtless serve as an effective object-lesson to the other swine and would deter them from committing any more offenses against men. The Duke found this argument convincing; and when the three murderers went to the gallows, the rest received a severe warning and were then released.

It was commonly assumed that lower animals possess a moral sense and could reasonably be expected to understand and obey man-made laws. But there were some jurists who held that the animal's owner was at least partially responsible for its actions. On January 10, 1457, a sow was convicted of "murder flagrantly committed" and was sentenced to be hanged. Her six sucklings were originally included in the indictment as accomplices. Positive proof was lacking, however, and they were released to their owner after he had furnished bail for their reappearance in the event that new evidence was uncovered. The man apparently believed in the inheritance of criminal tendencies, because after worrying about the matter for three weeks, he brought the piglets back to court, openly repudiated them, and refused to be answerable for their conduct in the future.

Swine were not the only animals guilty of criminal offenses. Cattle and horses occasionally ran afoul of the law and received precisely the same treatment as human criminals. Not only was the court procedure the same in each type of case; the same methods of execution were employed. The more common forms of capital punishment were hanging, beheading, or burning at the stake. Whenever possible, the animals were dressed in human clothes before the sentence was carried out.

Homicide was not the only crime for which animals were tried and punished. Jail sentences ranging from a few weeks to several years were not uncommon in cases of the willful injury of a human being by dogs, horses, cows, or other animals. In one Russian village a "he-goat" butted an important official while he was fastening his shoe, and as punishment the goat was banished to Siberia.

A German innkeeper's dog showed such poor judgment as to bite the leg of a village councilman. The animal's master was jailed at once, but he complained so vigorously against this miscarriage of justice that the judge ordered his release. After all, the innkeeper argued, why should he languish behind bars while the real culprit went free? Appreciating the logic of this approach, the court arranged for the incarceration of the dog for a period of one year. The sentence was duly served, and the animal shared its cell with two human prisoners.

Medieval methods of dealing with *wild* animals were, of necessity, more complicated. It was often

efore the Bar

Quaint court scenes of yesteryear show that ignorance of the law was once no excuse even for an animal

By Frank A. Beach

Department of Psychology, Yale University

▲ THE INNKEEPER'S DOG that bit the leg of a village councilman shared its cell with two human prisoners during its one-year sentence

impossible to capture and keep in jail the untamed creatures that sometimes brought harm to men. Nevertheless, the death sentence was occasionally imposed. In 864, the Council of Worms decreed death by suffocation to a swarm of wild bees that had stung a citizen to death. When animal culprits were not available for physical retribution, action of a different sort was possible. Insects and other pests that indirectly harmed a man by destroying his property could, with appropriate assistance from the clergy, be excommunicated. This extreme measure was not usually resorted to until milder alternatives had been exhausted.

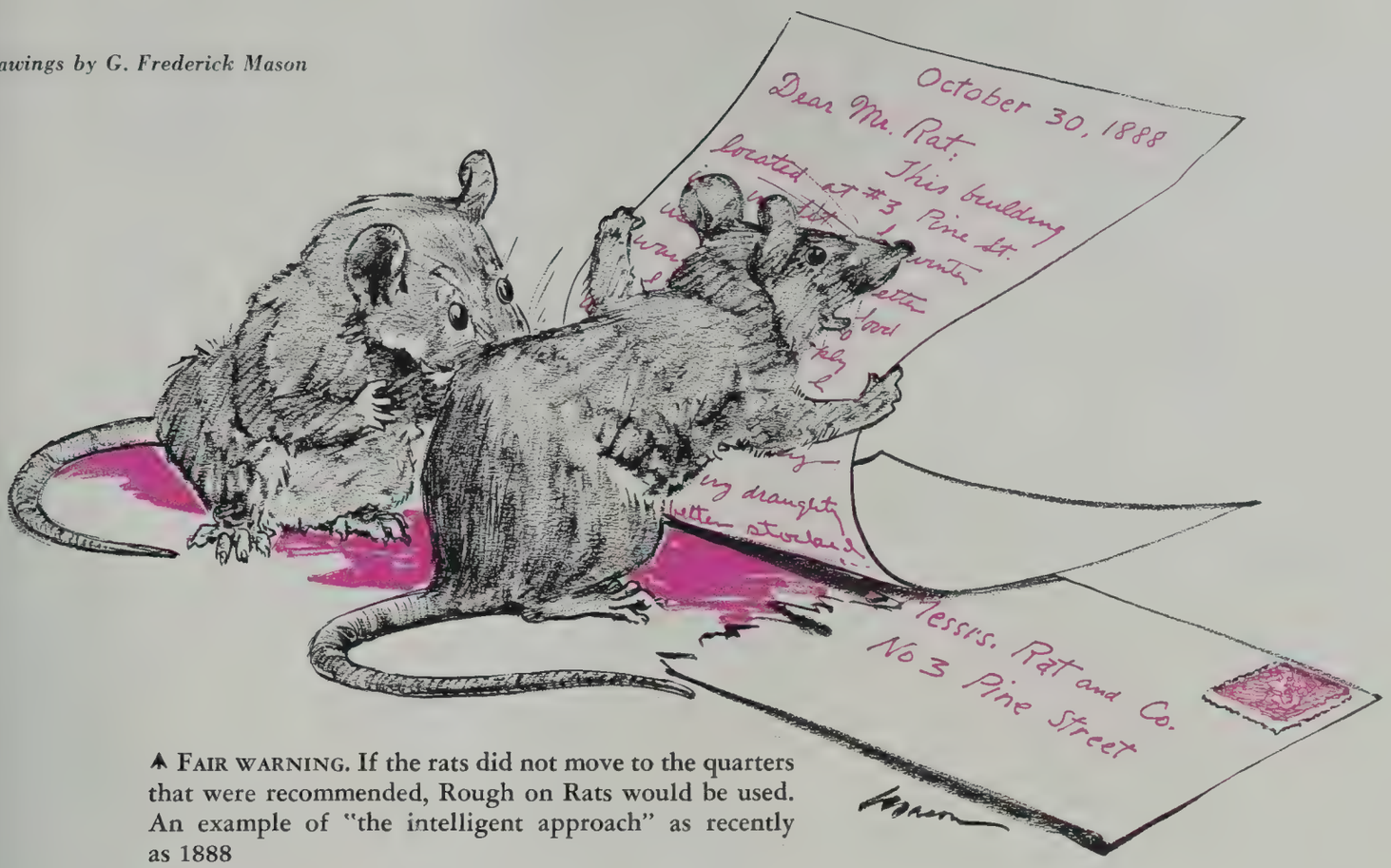
It was customary for example, to implore a swarm of locusts or a colony of rats to depart and cease whatever depredations they may have been committing. In some cases formal provisions for sanctuary were arranged, and the animals were notified by a Crier that they could take and maintain possession of a particular plot of land which had been set aside for their use. Usually the threat of excommunication was employed in an attempt to force the undesirable visitors to move away.

After the Middle Ages the Church grew less willing to participate in such animistic rituals as the excommunication of animals, but laymen continued to rely upon the efficacy of direct appeal to the presumed intellectual and emotional natures of lower animals. Sometimes the approach was informal and persuasive. In an old issue of the *Journal of American Folk Lore* there appears a copy of a letter dated October 30, 1888. It is addressed very correctly to "Messrs. Rat and Co." The writer begins with fervent expressions of his esteem for the rats and mentions his fear that they must find their present quarters at No. 3, Pine Street quite unsuitable for winter occupancy. He points out that the building was intended only as a summer residence and therefore is draughty and poorly supplied with food. By fortunate coincidence there is at No. 36, Sea Avenue a large, well-built house where the rats "can live snug and happy." The cellar is well stocked and a near-by barn contains large stores of grain. (Directions for reaching the address are included.) Having thus demonstrated his good intentions, the author of the published letter politely suggests that the rats take advantage of his well-meant advice. If they fail to do so, the letter concludes, "the undersigned, who owns the property at No. 3, Pine St., will be forced to use Rough on Rats."

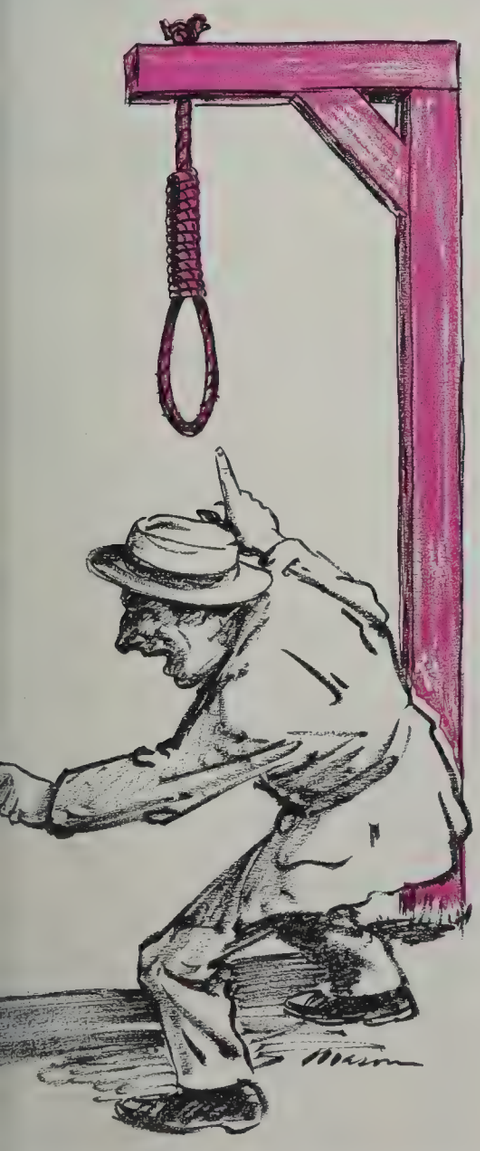
The ethical propriety of adjuring the vermin to move to a neighbor's house seems not to have concerned this gentleman. At that, he was only

▼ A PROVISION of the sentence that the accomplices be warned of punishment meted out to their m belligerent associates

Drawings by G. Frederick Mason



▲ FAIR WARNING. If the rats did not move to the quarters that were recommended, Rough on Rats would be used. An example of "the intelligent approach" as recently as 1888



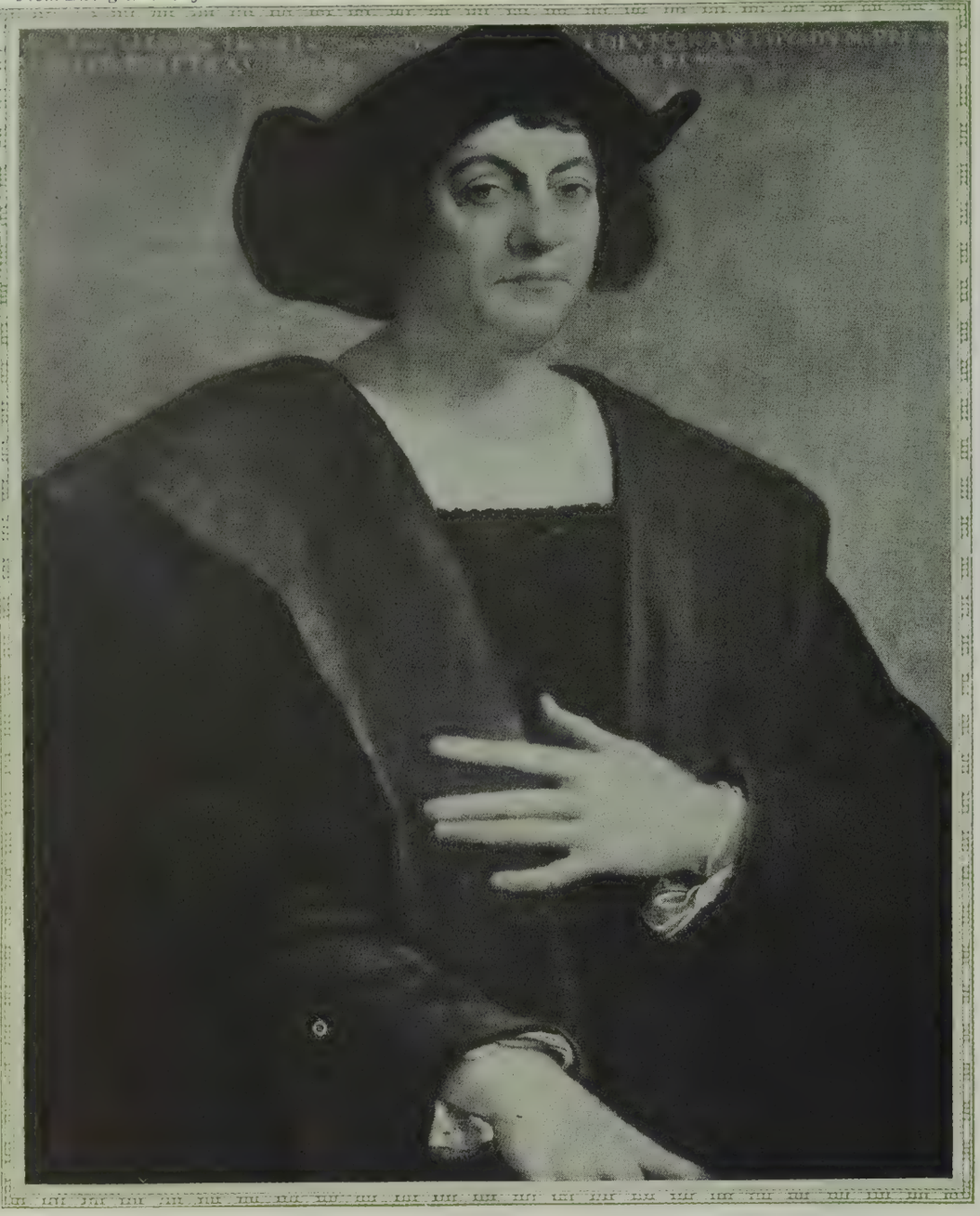
repeating, with minor modifications, the medieval offer of sanctuary. The more attractive the new abode, the better the chances of acceptance. Peasants in some parts of Europe followed a similar practice in attempting to get rid of cabbage worms. It was customary to go out into the garden and invite the worms to depart, calling out, "In yonder village is church-ale." Church-ale signified a festival which, the peasants must have assumed, no lively cabbage worm could possibly resist.

These historical accounts illustrate the universal human tendency to recognize certain similarities between ourselves and lower animals. In scientific jargon the tendency is termed anthropomorphism. It rests upon an implicit belief that other living creatures have the same kinds of psychological experiences as men and women. Probably many of the people who protested the killing of the circus elephant, Dolly, rationalized their objections by thinking of the precipitating event as an "accident." They may have felt that the animal did not "mean" to injure the boy. Regardless of their reasoning, these individuals were reacting precisely as human beings have reacted for many centuries.

Basic human attitudes and beliefs do not change rapidly. The notions that permitted our forefathers to try, convict, and execute animals as though they were criminals are not completely lacking from our own psychology in this modern and supposedly scientific age.

The difference is that our ancestors assumed that animals had a moral sense and that they either lived up to it or not. If an animal was guilty, it must be punished according to the same laws that applied to man. Today, we know a great deal more about the psychology of animals than our ancestors did and are in a position to know much better how a given animal should be treated. We should ask whether the offender is naturally vicious or whether it was goaded to violence by somebody's cruelty or carelessness.

The emphasis today is on proper precautions and laws to ensure public safety. Society demands that a dangerous animal be put where it can do no harm; but it also demands that the animal be treated humanely.



THERE ARE many pictures of Columbus, but few seem to portray the same man. This one, in the Metropolitan Museum of Art, was painted by the contemporary artist Sebastian del Piombo

The Sign

On the 500th Anniversary of the birth of Columbus, a modern scientist retraces the momentous voyage and shows how much the famous navigator depended on his natural history information—and misinformation

By N. J. BERRILL

McGill University

COLUMBUS first saw the light of day 500 years ago, in the middle year of the fifteenth century.* Forty-two years later he saw another light, as strange and puzzling as the first. And because he himself was the first to see it, and because the landfall came only a few hours later, Columbus in person was credited with the actual sighting of land.

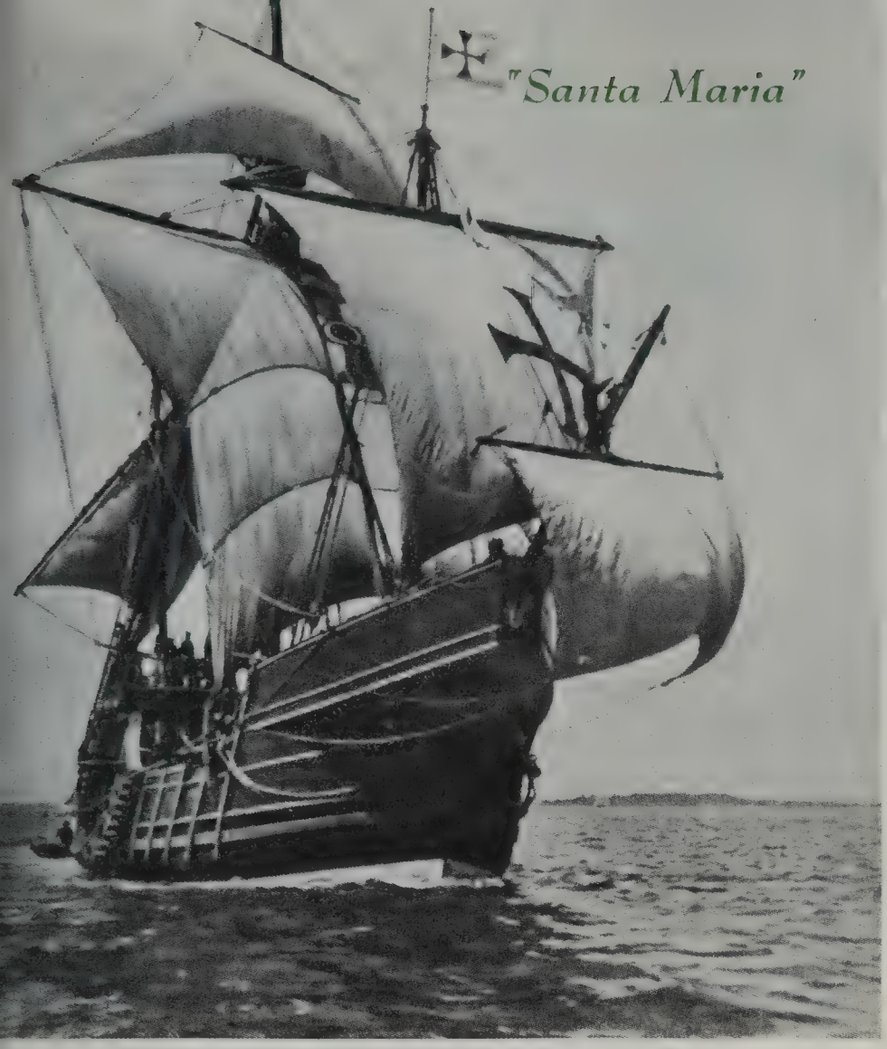
For days Columbus had been sailing on a westerly course that trended to the southwest, and expectation of a landfall was already running high. Late in the day of October 7 great numbers of birds were seen flying toward the southwest, and with the thought that they were going to sleep on land, Columbus changed his course from west to west-southwest. Land birds were seen all the next day, and birds were heard passing throughout the night of the ninth. Land seemed to be close, and hearts were uplifted. "Thanks be to God," said Columbus, "the air is very soft like April at Seville; and it is a pleasure to be here, so balmy are the breezes."

The "Nina," the fastest ship of the three, was already pushing forward, hoping to enjoy the handsome reward the Sovereigns had promised, and the Admiral had ordered that whoever should sight land first should hoist a flag at the masthead and fire a gun. At two hours after midnight on October 12, Rodrigo de Triano, a sailor on the "Pinta," saw the island in the moonlight.

This was the landfall, but what of the light? Columbus had been alone on the castle of the poop earlier that night, at ten o'clock—long after dusk and before the moon had risen. In the darkness of the night on the edge of the tropics, he saw a light and called to his companions. They saw it several times, and it was compared to a wax candle flame rising and falling. Columbus himself thought it was a sign of land, but no more than that; and decision that the light was actually on land—the decision that gave Columbus the award and later sent Rodrigo a disgusted renegade to Africa—was made virtually by default. No other explanation of the light was forthcoming.

The first sight of land was in the light of the moon and at a distance of six miles. Land as low-lying as these islands, seen from ships as small as the "Santa Maria," would seem to lie pretty well on the horizon at that distance and could hardly be seen much farther away. The light had been seen 4 hours earlier; and at the speed recorded at

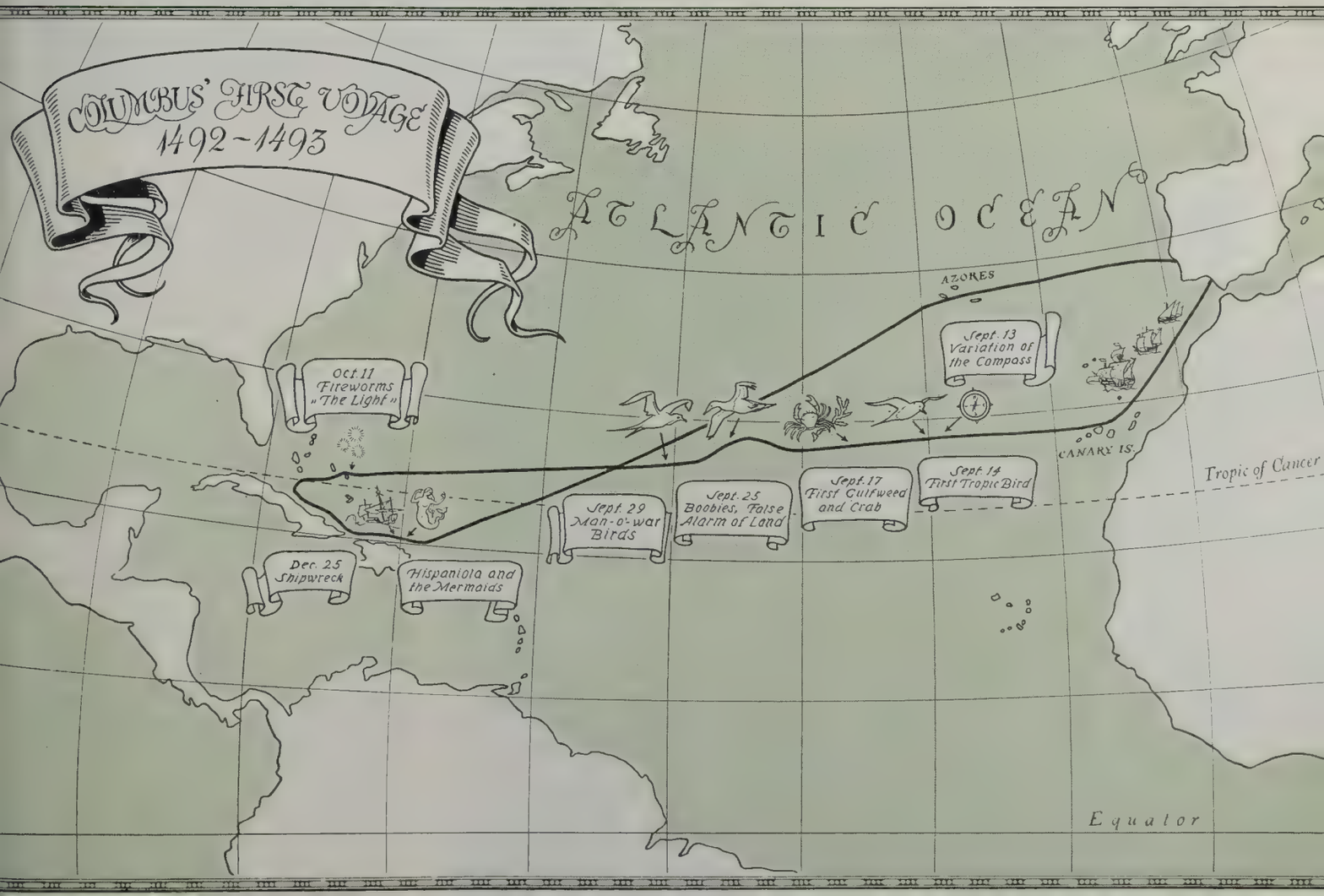
* Estimates range from 1446 to 1451.



MODELS of the three ships used by Columbus on his first voyage to the New World

from Brown Brothers

lumbus Followed



From Ewing Galloway

▲ A PAINTING depicting Columbus before Queen Isabella, succeeding after years of effort to secure assistance for his voyage to China and the Indies. Neither dreamed that a whole new world would be discovered. Had Isabelle known he would not reach the Orient, his voyage might not have taken place

The Bettmann Archive

➤ AN IMAGINATIVE PORTRAYAL of Columbus' first landing in the New World. Natural history signs recorded by the explorer now indicate that this spot was on Cat Island rather than San Salvador

▼ THE WRECK of the caravel "Santa Maria" on the coast of Hispaniola on Christmas Day, 1492. Engraving after Adolph Closs

The Bettmann Archive

the time, 35 to 45 miles had been traversed in the interval. So the light could not have been on the island that became San Salvador.

The question of the light has worried many people. An unexplained mystery bothers a man like an unfinished sentence, and the simpler the facts, the more we look for an answer. Suggestions that it was a light in a native canoe or a product of pure imagination are hardly credible, for the canoe would have been dangerously far out in the Atlantic, and the record is too detailed to be one of hallucination.

In recent years another explanation has appeared that fits like the missing piece of a jigsaw puzzle. The answer, of all things, is worms!

A delicate little sea worm, one to two inches long, lives abundantly among the rocky reefs of the Bahamas. This is the fireworm, brightly luminous in the dark, and it regulates its habits according to the state of the moon.

When it is time to spawn, the worms leave their homes among the coral in shallow water and swim to the surface of the sea. The females shed their eggs with an intensely phosphorescent slime, shining with the same light that fireflies flash in summer evenings. Groups of worms arrive suddenly at a given spot at the surface, flash several times, and as suddenly disappear. If the watchers on the "Santa Maria" saw the flashing fireworms from a distance of 100 to 200 yards on a very dark night, they would undoubtedly have received the impression of a candle waxing and waning, and they could not have judged the distance. The fireworms could have produced the right kind of light. Could they have produced it at the right time?

The worms spawn every month, winter and summer, but they pick their own time. They rise only when the sun has long set and before the moon has risen. Before the moon is

From Ewing Galloway

▲ STATUE of Christopher Columbus at Trujillo, San Domingo, one of the islands the navigator touched on his first voyage. He was once buried in the cathedral in the background, but his remains now lie in Seville

away, passed unnoticed in the pitch darkness. Cat Island is about 50 miles to the west of the reef in question, the right distance for it to be Columbus' San Salvador. That is where his expedition probably first saw land.

It is none too easy to put ourselves back into the fifteenth century and see things as they seemed during the dawn of the Renaissance, when men's minds were stirring but were still imbued with the legends and myths of medieval Europe. It was a time for adventure, but there was little experience. Columbus himself was at heart a mystic and a poet, a man with an overpowering vision, but he was not a professional navigator. The expedition was into the great unknown, and the men were afraid.

Putting out from the Canaries, the ships steered westward, and as the smoking peak of Tenerife sank below the eastern horizon, those on board must have felt that all that tied them to their past lives was severed. But 6 days later and 600 miles to the west, the invisible forces of the unseen world made their first sign. The compass needles no longer pointed to the North Star but more and more to the west, swinging a full degree between night and morning, and all were amazed, for it had never happened before. The

full, it is in the sky earlier than sunset, and there is continuous light. The full moon rises as the sun sinks below the horizon, and not until several nights afterward, when the moon is approaching the third quarter, is there a fair interval of complete darkness between sunset and moonrise. And so, each month, commencing a couple of nights after full moon, the worms leave the island reefs on several consecutive nights to display their ethereal light at the surface of the sea until no eggs are left.

Columbus saw the light at 10 P.M., two hours or so after sunset, an hour before moonrise, as he wrote in his journal. There is little doubt that the fireworms were busy about their luminous duties at the time the light was seen. It is only reasonable to assume it was the same light.

So what becomes of Columbus' San Salvador? It could not be what we now call San Salvador, or Watlings, for that island lies like an outrider along the outer bank of the Bahamas, and it would place the fireworms some 40 miles away from the reefs, in deep water where they do not perform. The "Santa Maria" probably sailed close to the reefs that lie off the northern shore of Watlings, and the spawning lights were seen at that point. The low-lying island itself, about four miles

▼ THE RECEPTION of the explorer at the court of Barcelona is said to have been the most magnificent in all Spanish history. He brought six Indians with him and various plants, animals, and minerals from the New World

The Bettmann Ar

magnetic pole was unknown, but the conclusion Columbus drew was sound: the needles do not point to the Pole Star but to an invisible center not far off the line. This discovery alone would have made his name remembered.

The following day "those of the caravel 'Nina' reported that they had seen a tern and a boatswain bird, and these birds never go more than 25 leagues from the land." The phrase is significant, though it certainly does not mean that the hard-bitten sailors on the "Nina" had any great interest in birds as birds. But they knew well, as did every man in the expedition, that the Portuguese had discovered the Atlantic islands of the Canaries, the Azores, and Cape Verde by noting the direction of flight of birds at sea. It was of vital importance to know which birds rested or slept on the sea and which on land, and how far from land they could roam. So we find here a conclusion (based on the presence of the boatswain bird in particular, since it was the more precisely identified) that there was land, probably an island, somewhere within 100 miles. The bird was a sign, but was it a true sign?

All four voyages of Columbus have now been pretty well charted; and when the bird was seen, no land was closer than the Azores, 600 miles to the north. The conclusion was logical; mariners were accustomed to seeing the birds within a certain distance of land. The pitfall lay in the incompleteness of the information, which leads men astray at every turn. What the Admiral and his captains did not know was that tropic birds, or boatswain birds, merely tolerate land for the brief two months it takes to raise their families. For the rest of the year they roam the tropical ocean as far from land as it is possible to get. No one who has ever crossed the Atlantic Ocean between Cancer and Capricorn can forget the sudden visit and shrill whistle of the boatswain bird in tropical waters where birds are scarce — a white, gleaming, long-tailed creature passing on rapidly beating wings and streaking away like an animated comet. Scientists have well named it *Phaëthon,* the son of Apollo, who hurtled from the far sky into the sea. A sign of land or not, no symbol could have better graced the first voyage into the unknown ocean.

A few days later another tropic bird flew by—an early omen in a day long remembered. The compass needles turned a full point to the west, to the alarm and dejection of the mariners. This was at dawn, and it was on that same Monday morning that the weed swept by the ships —weed in which they found a live crab. Seaweed torn from a shore so recently that a hapless crab enmeshed in it was still alive; a boatswain bird; and soft breezes! Is it any wonder that "everyone was pleased, and the best sailors went ahead to sight the land first," all signs coming from the west?

Once again the signs were false, and the ships had yet to reach the mid-Atlantic. But like the variation of the compass, Columbus was seeing for the first time something unknown to Europeans, though the ancient Phoenicians—sailors who once sailed from the Mediterranean to Iceland and ventured far out into the tropical ocean—may have seen it, too. Columbus was entering the Sargasso Sea, a sea of floating weed in the middle of an ocean, a sea that became a legendary terror to seamen of later times. Great masses of floating weed sometimes cover the ocean as far as the eye can see, and strange rumors grew that ships became caught in it, finally to rot and sink.

The reality is otherwise, though no less strange. Sargasso weed, no matter how extensive it seems, hardly impedes a ship, though lack of wind may enhance the illusion. But the weed is peculiar, for it lives and grows as a floating seaweed of the warm oceans, far from land or even shallow water. Its spiky growing tips and bladder buoys give it a distinctive appearance, as Columbus well noted. And it has so long drifted with the ocean currents that sea animals have changed and adapted themselves to a life among the weed as though it were a world in itself, all of them taking on the yellow-brown colors of the floating fronds. Not only are crabs to be found among it, but peculiar small fish called fishing frogs cling to it and are so well camouflaged by color and shape that they are practically invisible. Certain small snails and worms, not to be found elsewhere in the world, also live among the weed.

Ignorance is often bliss, and had Columbus and his men known the sign of the weed and the crab for what it was, their hearts might have failed them. As it was, the weed increased as the ships sailed west, and other signs no less false came to keep their courage high. Ten days and more than 1200 miles from the Canaries they saw boobies and a whale—boobies that "sleep on shore and go to sea in the mornings in search of food, not extending their flight more than 20 leagues from the land," and a whale they thought always kept close to shore. They ran into smooth seas and a drizzling rain —weather that was a sure sign of land. And to cap it all, they saw sandpipers and a dove. Land must be near, and at sunset on September 25, all thought they could see it in the far distance. Columbus knelt down and gave thanks to the Lord.

Where were they? They were in mid-Atlantic, as far from their landfall as from their point of departure, about 1500 miles from the West Indies, from South America, from Newfoundland, or back to the Canaries! Anything that upheld their faith at this time was all to the good. Or perhaps their optimism was wishful thinking. For whales had been seen only close to shore, because men had not sailed far enough to find them elsewhere. Boobies, large sea birds like the gannets of northern seas, had been seen only in nesting colonies on islands, when they naturally stay close to the young they have to feed. And the sailors did not know the sandpipers as the phalaropes that take the ocean for their own; nor did they realize that the dove was a noddy tern, a bird with the size and plump grayness of a dove but one that ranges through the tropical Atlantic.

Hope deferred left boredom in its wake, and at least the sight of boobies—high-sailing birds with a six-foot wingspread—must have relieved the monotony of incessant sailing into a boundless ocean. The mariners knew them well, for like the tropic birds, the brown boobies include the Cape Verde Islands among their nesting places. But also like the tropic birds, they wander far from land when family duties are over. What held the interest of the men on the "Santa Maria" and the two caravels was the proficiency of these birds at fishing. Boobies are called boobies from the Spanish word *"bobo,"* for "dunce," because they pay little attention to human beings and will allow any sailor to knock them on the head with a stick. But they make up for this by their sheer mastery of air and water. Over blue water, where they belong, they dive from masthead heights or higher, suddenly pitching downward and flying fast until about fifteen feet from the water. Then the wings close, and the birds enter the water like aerial torpedoes.

The land so thankfully seen became only clouds on the horizon. Yet hope persisted, for the sea was as smooth as a river, so smooth that many sailors bathed alongside the ships. They saw a good many dorados — high-headed, voracious fish weighing as much as 60 pounds and often 6 feet long. The dorado is as oceanic as the tropic bird and one of the fastest swimmers in the sea. The bathers must have taken some pleasure in its shimmering colors, for they are a brilliant green or blue above, shading to silvery-white below, with purple and golden reflections; and they have bright blue spots on the head and back. Some of the fish were caught, and the sudden fading of the colors as the fish died on the deck made even the sailors silent for a moment.

For several days the dolphins stayed with the ships, and while flying fish are not mentioned in the journal until somewhat later, there is little doubt they were all about, for the two go together. Flying fish are recorded only once during the voyage, about a week later, and then apparently because large numbers actually landed on deck. Maybe it was just as well that most sailors were familiar with them in the seas south of Portugal, for otherwise fish that could fly might have been taken for a sign of heaven, let alone a new earth.

The flight of flying fish is a thrilling sight, no matter how often you see it. The flight starts as a swift rush at a low angle up to and through the surface, usually with the open jaws of a dorado or a bonito close behind. As the fish leaves the water, the lower lobe of the tail vibrates violently and propels the fish into the air at not less than 35 miles per hour. Then the great pectoral fins stretch out stiffly and flight begins; the silver bodies steer up and down the waves and along them, as gracefully as any petrel and at all angles to the wind. The fins are used entirely as planes, and all the power comes from the tail dipping in the water and from the wind itself. With three or four reinforcing dips, a quarter mile may be covered, and perhaps by then the dolphin may have lost the trail.

When the first true sign of land really did come, it was so mixed up with the false that it had no unusual import. On the twenty-ninth day of September, man-o'-war birds or frigates sailed overhead, and in this case the account is almost correct. The bird "makes the boobies vomit what they have swallowed, and eats it, maintaining itself on nothing else. It is a sea bird, but does not sleep on the sea, and does not go more than twenty leagues from the land. There are many of them at the Cape Verde Islands."

Man-o'-wars have been seen to swoop on an ascending booby, seize it by the legs, and turn it head over heels in midair—a sure way to make it disgorge its fish. Yet they probably get the bulk of their food by their own efforts, plunging toward the sea from great heights, making a sound like the hiss of an arrow shot into water, and then, without wetting feathers or feet, rising and tossing up the prey before swallowing it. In actuality, the skittering flying fish are literally caught between the devil and the deep blue sea.

These birds are distinctly not ocean wanderers like their dainty relatives the tropic birds, and they usually cling closely to their island homes. Their great chest muscles make up a quarter of the whole body weight, and the wings are proportionately larger than those of any other bird. Yet despite, or perhaps because of, this equipment, the man-o'-war can only take flight readily from a bush or the edge of a cliff and never rests upon the water. But it can fly through gale and hurricane and can make much longer sorties from the islands than the 20 leagues of Columbus gave them.

When he saw man-o'-war birds for the first time, the nearest land was Puerto Rico, about 700 miles to the south. This is puzzling, for careful studies have indicated that man-o'-war birds do not ordinarily fly more than about 200 miles from their breeding or resting stations. Severe storms have no doubt occasionally carried them farther. Or maybe there is a mistake in identification here.

So for another week, boobies and frigates, dorados and flying fish, and weed marked the track of the three small ships, until suddenly the Bahama banks rose steeply from the deep ocean abyss, and the flat islands of Paradise stood in their way. They had come to land.

They found the children of the dawn on the islands—comely, naked, gentle Indians who greeted them in innocent friendliness. Columbus was much taken with them and with the soft, calm beauty of the sunny isles; but he had a purpose to fulfill and could not linger long. He went on to take possession of all the little islands for the Sovereign of Spain. But more than this, he was searching for the island of Zipangu, described by Marco Polo as having abundant pearls and palaces roofed with gold. This island (actually Japan) and the courts of Kublai Khan on the mainland of China, were the real objectives, and gold was now the sign to be followed in place of birds and weed. Some gold was

Continued on page 382

▲ "UNCLE SAM" swings his baton as he leads a choral group past the judge's stand. The exciting musical festival of the Cape Negroes is replete with Americana

▼ THESE CHORALERS imitate the long bow ties and dapper canes typical of the American minstrel's costume

DIXIE IN REVERSE

The Negroes of South Africa are borrowing back some of the purely American adaptations that their cousins in the United States have developed

By QUENTIN KEYNES

Photographs by the author

THE cultural elements that the Negro brought from Africa to the United States in slave days did much to enrich American cultural tradition, particularly in musical patterns and dance rhythms. In this country these traditions were influenced, in turn, by other elements quite foreign to the African scene. One of the purely American developments was the minstrel show, which originated here early in the nineteenth century—a kind of musical comedy in which Negro spirituals and humor were adapted to an altogether new national background.

Strange as it may seem, this purely American institution is now being borrowed back by the natives of Africa—but in reverse. At an annual carnival staged in Cape Town, Union of South Africa, the Cape Negroes smear their mouths with white, Al Jolson style, don American costumes, sing American songs, and carry American signs.

Over 1000 of these high-spirited people take part in this carnival at the fairgrounds, chanting many current American and traditional Afrikaans songs. One of the most

▼ GUITARS AND BANJOS accompany the singing of current American and traditional Afrikaans songs

▲ "CAKEWALKING" across the fairgrounds in true minstrel fashion. Lips are painted white, mimicking the Al Jolson style

interesting numbers is an old Cape "Malay" melody called "Daar kom die Alabama."

The singers march by in groups to compete for the choral prizes, and each group is good-naturedly identified with the name of an American state. The Louisiana group goes so far as to bring Louisiana into the British Empire by including on the sign: "May God Bless Our Royal Highness Bonny Prince Charles of Edinburgh."

Banjos and painted mouths are everywhere. One figure proudly represents Uncle Sam himself in red-striped pants, top hat, and blue-tailed coat!

The origin of the carnival dates from the visit of the famous Confederate raider, "Alabama," to Cape Town in July, 1863. As the vessel approached the harbor, a Union barque, the "Sea Bird," which had desperately sought to avoid the Confederate ship for some time, made its appearance from the opposite direction. It was soon evident to the hundreds of local inhabitants, who had by this time lined the water front, that the raider was intent on seizing the hapless Union ship. The "Alabama" fired a blank charge at the fugitive, bringing it immediately to bay, and steamed triumphantly into Cape Town with the surrendered ship in tow. Visitors streamed on board the captor, and her captain was the hero of the day. The happy ending to this story came when the local Prize Court awarded the "Sea Bride" as a legal capture. For years this exciting event was discussed at every bar in the Cape and so eventually found its way into song.

The curious American influence on this musical festival may have come from some members of the "Alabama's" crew who were inadvertently left behind when she sailed. Other sources are undoubtedly the many American movies shown in the theaters of Cape Town. At any rate, everyone concerned has a wonderful and exuberant time.

▲ THE "FEATHER HEADDRESS" may have been imported from the American Indian or it may represent an adaptation of a native African design

◀ THIS GROUP identifies itself with the State of Pennsylvania when competing for musical honors. The partially white faces are variations of the white-lips theme

▲ A HEN'S-EYE VIEW of a male sage grouse displaying. At the height of the display, the inflated air sacs, partially hidden by the white ruff, collapse with a *plop* that can be heard for over a mile on a calm day

SAGA of the Sage

An early morning vigil on the sagebrush plateau of Wyoming results in a thrilling educational film on the courtship ritual of the sage grouse

By CHARLES W. SCHWARTZ

Photographs by the author

OF all avian courting displays, those of our various prairie grouse are among the most spectacular and colorful. Pinnated, sharp-tailed, and sage grouse have in common the habit of gathering each spring on ancestral sites where the cocks perform their age-old nuptial rituals at dawn and dusk.

In the course of filming the sound picture "Sunrise Serenades" for the American Museum of Natural History, which depicts the strange court-

▲ SOME of the dances and accouterments of the Plains Indians are believed to have been patterned after the displays and plumage of the prairie grouse

ship of these three prairie grouse*, Edgar M. Queeny, producer and photographer, Ralph Piper, sound technician, and I as biologist and co-photographer journeyed to different parts of their ranges. On the vanishing bluestem prairies of Missouri we photographed and recorded the sound of the mincing, dancelike steps of the pinnated grouse and its booming song. The aspen pothole country of southern Saskatchewan and southern Manitoba was the locale where we filmed the running dance of the sharptails. And on the 7000-foot-high sagebrush plateau of central Wyoming we pitched our blinds and recorded the pompous strutting of the sage grouse, shown in these photographs. The latter impressed us as the most spectacular of the three displays.

* "Sunrise Serenades" was released recently by Encyclopaedia Britannica Films, Inc. Another motion picture, a ten-minute classroom film entitled "Grouse of the Grasslands," will feature the courtship of the pinnated grouse. This will be released on October 15 by the same organization.—ED.

The strutting ground where we filmed this epic was an opening of little more than an acre in the ubiquitous sage. The sandy soil, supporting a sparse growth of hardy grasses, was marked by numerous grouse tracks, a few scattered feathers, and an accumulation of droppings. According to our host, Bob Patterson, who is making a study of the sage grouse in Wyoming as a biologist with the Wyoming Game and Fish Commission, there were 47 such strutting grounds in the 250 square-mile area he had under observation in this vicinity. This is an average of one ground for each five square miles.

Sage grouse cocks customarily display on their strutting grounds at dawn and dusk from late March until early June. But at the height of their mating season, in mid-April, which we selected as the time of our observations, they may even continue their display throughout the night.

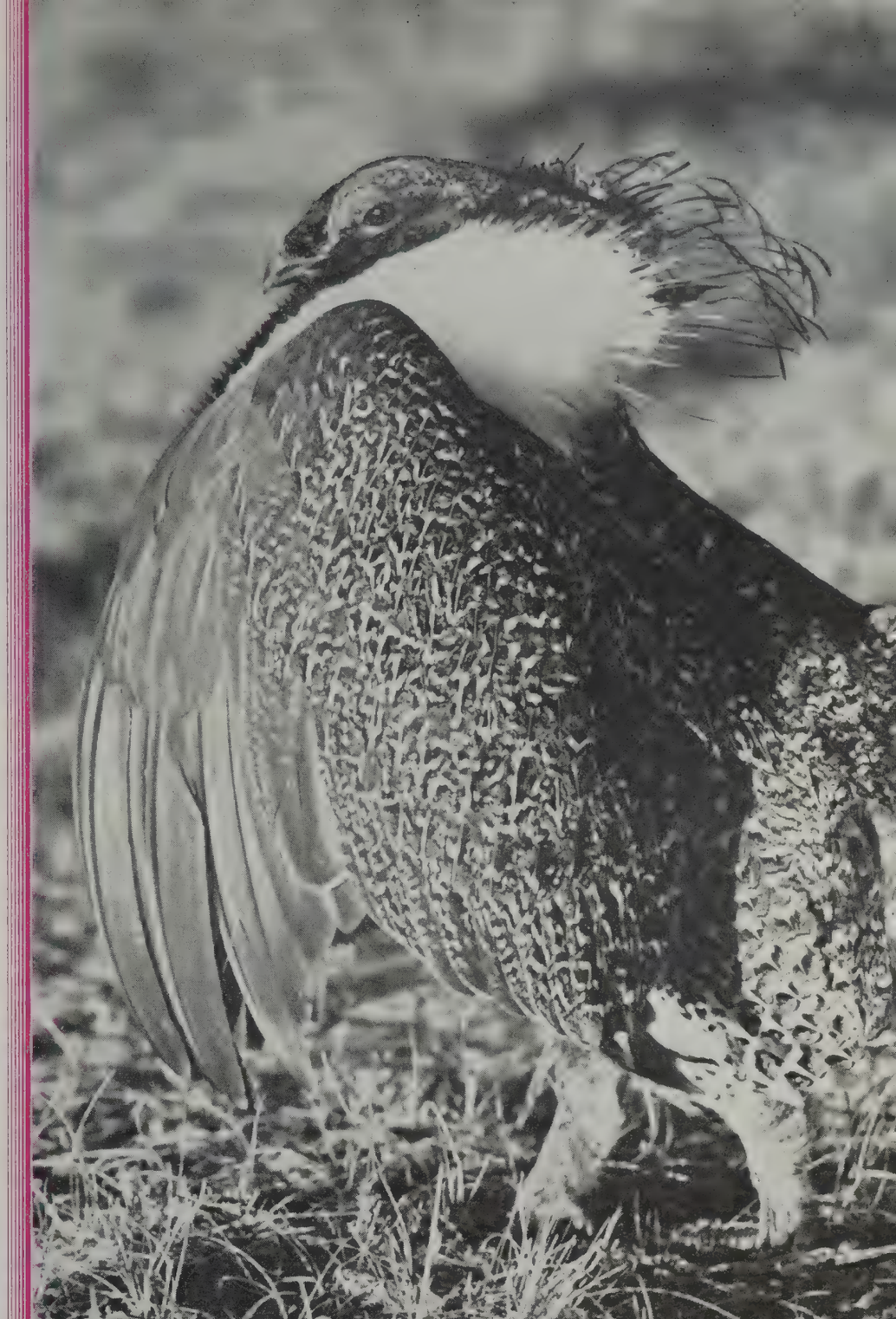
It was 3:45 A.M. when we drove up to our blinds on the strutting ground we had selected the previous day. The headlights of our car momentarily illuminated the scene, and we could see the sage grouse cocks actively displaying. Our sud-

▼ EDGAR M. QUEENY beside one of the camouflaged blinds from which the photographs were taken. His 16 mm. Maurer camera stands on a unipod of his own design. The windows close by zipper

▶ AFTER the morning's recordings, Ralp has removed the cover of the blind and paring to audit some of the sage grouse

den appearance stopped the show; some of the cocks took wing, while others retreated into the shadows of the surrounding sagebrush. We took advantage of this lull to scramble into our three blinds. One was used exclusively for the sound equipment, the other two for photography. All had been placed on the eastern edge of the strutting ground so that the rising sun would light our "stage" to best advantage — a necessity when using color film just after sunrise. The camera blinds were spaced about 80 feet apart in order to achieve different shooting angles and to ensure better coverage of the ground.

Within five minutes the cocks started to return and promptly resumed their displaying. In the dim moonlight, their huge white-neck ruffs stood out like apparitions, and the weird sounds they made while displaying added to the enchantment of the scene. As the darkness imperceptibly dissolved into daylight, the birds became more and more visible. Because the presunrise light was too weak for good color movies, we devoted this time to observing and enjoying the spectacle before us. There were 102 males, rather evenly distributed over the



▲ PROFILE of a strutting sage grouse cock. The under surfaces of the wings are scraped against the stiff basal portion of the white neck ruff to create the swishing sound

open strutting ground and in the sagebrush roundabout. Patterson told us that the number of males utilizing different strutting grounds varied considerably. The smallest number he had seen was 11, the largest, 450. He believed that on any extensive sagebrush tract the number of males on the strutting grounds represented the total male population for that area. It is probable that each ground is regularly attended by the same cocks.

One cock, which was strutting less than twelve feet from my blind, afforded a splendid opportunity to observe the imposing display. With his long tail feathers spread fanwise, head held high, and wings partially thrust forward, he advanced a few steps. Then, with a slight retraction of the wings and a jerk of the head and neck, which caused the stiff feathers on the basal portion of the

▲ THE WHITE RUFFS of the strutting cocks cause the birds to stand out conspicuously. Most of the cocks occupy the opening in the sage, but a few possess territories in the surrounding sagebrush

ruff to scrape against the underwing surfaces, an audible "swishing" sound was produced. These movements and the sound, which reminded me of the noise made by lightly brushing a hand over taffeta cloth, were quickly repeated. During these actions, the strutting cock rapidly inhaled and then exhaled the air into the esophagus, whose thin walls thus became inflated to form the pendulous air sacs. After the third inhalation, the air would be quickly exhaled, causing the air sacs to collapse with a sharp "plop," which resembled the sound of an acorn falling into water. The whole process, culminating in the plopping, was repeated successively at intervals as short as ten seconds.

Through the peepholes of the blind other birds could be seen strutting vigorously, and in the quiet morning air the swishing and plopping intermingled in a veritable sunrise serenade. When heard at close hand, these sounds do not seem harsh or loud, but on a calm day the plopping carries for over a mile.

As this grouse strutted pompously before the blind, a neighboring cock, rattling his tail feathers and uttering a grunting sound like a rooting hog, suddenly sidled up to him. Immediately, the strutting cock ceased his display and with a couple of rapid blows of his wings buffeted his opponent, who reciprocated in a like manner. After this round, the two contestants paused for a second or two and then struck out again with their wings. Though the onslaughts were spirited, little damage was inflicted, and only a few feathers floated up out of the swirl of dust caused by the conflict. Following this engagement, the birds paused again, and without further ado the challenger pivoted about and went strutting off to his original stand about fifteen yards away.

We noticed that such bouts were common throughout the strutting ground. It is not unlikely that they represent disputes over territories maintained by individual strutting males. Of course such territories have no hard and fast boundaries, but each male did seem to exert a dominant influence over the few square yards of sandy soil he patrolled. A similar territorial pattern is observed on the courting grounds of other species of prairie grouse.

At the far end of the strutting ground, a few hens could be seen making their way along its edge. Even at this distance they were easily distinguished from the cocks by their lack of a white ruff and by their smaller size and general behavior. In contrast to the pompous appearance of the cocks, the hens seemed almost demure and shy. Occasionally they would pick up a morsel of food, paying scant heed to their ardent suitors, who in the hens' presence displayed even more spiritedly.

Gradually the number of hens increased until ten were grouped in a rather loosely organized flock while four others strayed about the ground individually. The flock of ten spent their time in the vicinity of one particular male, and four of these hens were observed to mate with this cock. Since Patterson had seen 40 females on this strutting ground a few days earlier, it is likely that the peak of mating was almost over and that even fewer hens would appear hereafter each day. Just before sunrise, the hens started to wander off individually through the sagebrush. Those that had mated successfully probably would not return to the ground but would seek a secluded site in the sage in which to nest. Females whose nests and eggs have been destroyed doubtless return to the ground later and mate again, for the cocks continue to display until early June. Thus, the prolonged use of the strutting ground has its function.

With the departure of the hens, the males' strutting diminished in vigor and frequency, and they spent more time in territorial disputes or just idling and preening their feathers. With the coming of sunrise and its welcome light, we started to

record on film the scene we had been so eagerly observing. Although light conditions kept improving for photography, our chances of filming good activity steadily decreased because the climax of the morning's activity had been reached. To overcome some of this difficulty, we resorted to a ruse we had used successfully to stimulate activity in the pinnated and sharp-tailed grouse. We played some of the sounds recorded earlier in the morning during the period of intense displaying by the cocks in the presence of the hens. The results were astonishing. Upon hearing this vigorous plopping and swishing, the cocks were aroused out of their lethargy and were stimulated to renew their energetic displaying. Thus, in good light we were able to secure photographs of activity that otherwise would have been impossible. However, after a time, even this artificial stimulation began to lose its effect and most of the grouse quieted down.

Gradually the birds began to leave the ground, some flying and others ambling off through the sage. By 7:30, all had vanished not to return until dusk, when they would again fill the desert air with the sounds of their wooing. With the departure of the last bird, we eased out of our cramped quarters. Only then did we realize that we had spent four hours witnessing one of the most remarkable of wildlife dramas. While dismantling our camera equipment, we discussed with Bob Patterson some of the problems concerning the future of this bird.

According to him, the original range of the sage grouse coincided with the distribution of sagebrush and salt-desert vegetation. This area roughly encompasses the Great Basin and central Rocky Mountain region from 2000 to 7500 feet above sea level. The bird depends solely upon sagebrush and associated plants for the major part of its habitat requirements during all seasons. In times of heavy snow and severe ground blizzards the sage at high elevations is sometimes covered by snow. Then flocks numbering several hundred birds and composed mostly of females and juveniles may fly as far as 100 miles to lower elevations where the sagebrush remains exposed. Often these areas represent extremely arid regions, which cannot be utilized for breeding range in the summer.

A chemical analysis that was made by the Wyoming Experiment Station shows the leaves of the common sagebrush (*Artemisia tridentata*) to be highly nutritious. The protein content is equal to and the carbohydrate content greater than that of the best alfalfa meal; the amount of fat is twelve times that of alfalfa meal. No wonder the sage grouse utilizes this plant almost entirely as a winter food, since the fat has a high capacity for producing heat. Even during the winter of 1948-49, which is considered one of the most severe in the history of Wyoming, there was no evidence of abnormal loss of sage grouse. They were able to obtain their customary nourishment from the sage.

The inroads of civilization have dangerously lowered the grouse population. Agricultural reclamation projects embodying irrigation of desert land and heavy grazing by domestic livestock have greatly reduced the original domain of the sagebrush and the salt-desert shrub vegetation. A by-product of these "advancements" — indiscriminate shooting — has likewise influenced the birds' decline. The immediate plans for this vast arid domain call for the development of numerous dams and a network of irrigation projects. These will harm not only the sage grouse but numerous other species of wildlife, including big game. Because extensive and contiguous areas of native vegetation are essential for the sage grouse, this bird will inevitably decline unless special provision is made for its survival over reasonably large areas.

▲ TWO SAGE GROUSE COCKS pause before buffeting each other with their wings in what might be considered a dispute over courting territories. Little harm results except the loss of a few feathers

AMNH Photo

▲ PHOTOGRAPH of a greatly enlarged model of the male malarial mosquito (*Anopheles maculipennis* Meigen)

The Lady LIVES ON BLOOD

Little-known facts about a well-known creature—the mosquito

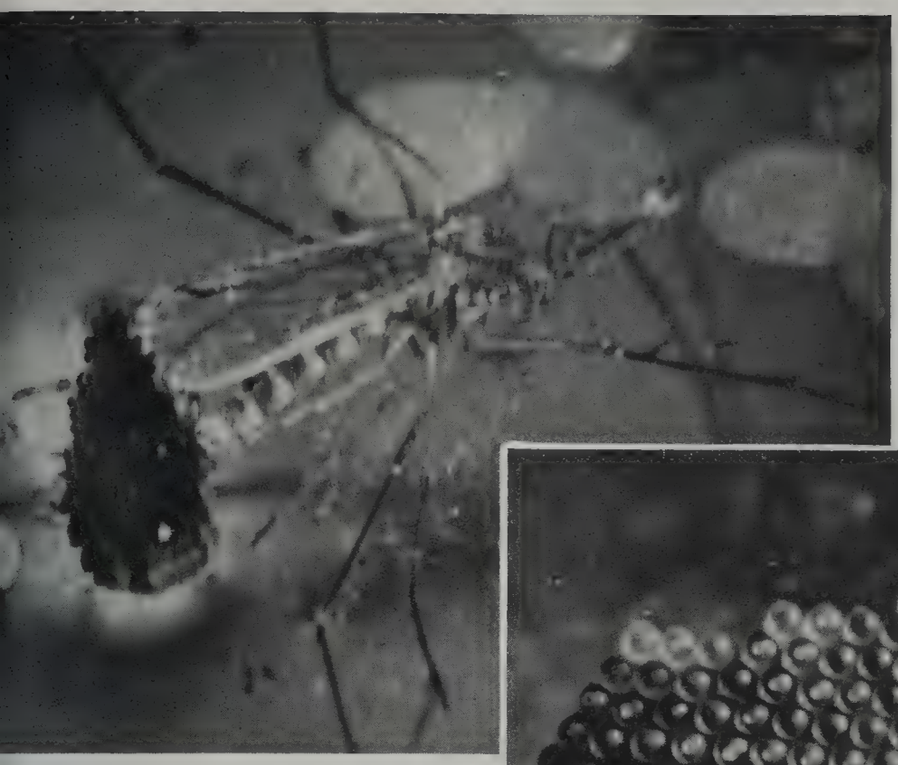
By MARSTON BATES*

Photographs by LYNWOOD M. CHACE
for Encyclopaedia Britannica Films, Inc., unless otherwise credited

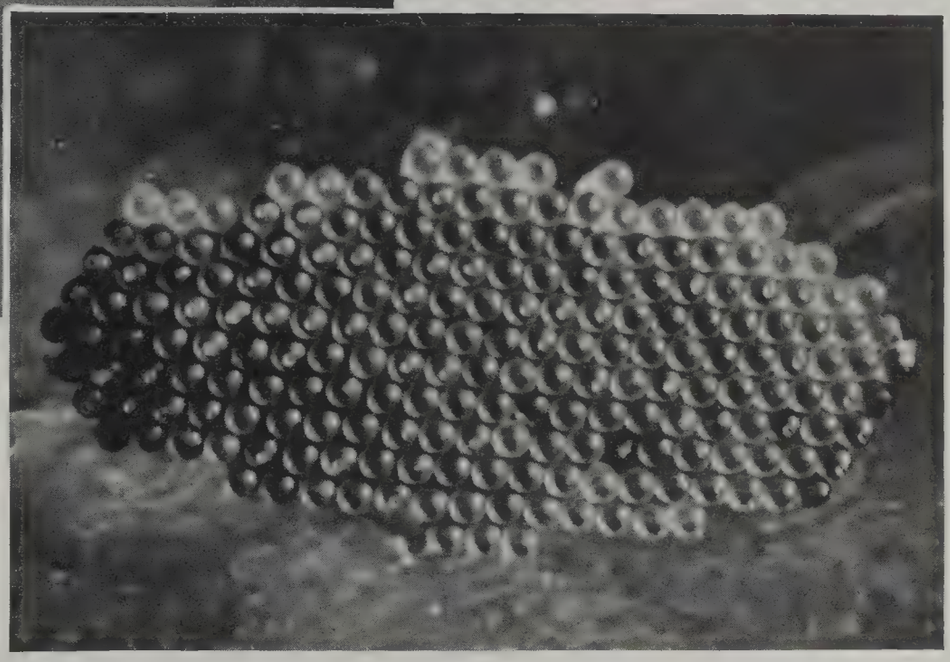
EVERYONE is familiar with mosquitoes. Those poor people who have never been outside the region of Western civilization characterized by modern plumbing may plausibly deny acquaintance with bedbugs, lice, ticks, leeches, or even fleas; but they have all encountered mosquitoes either on picnics or, more intimately, in the bedroom.

Most of us have repeatedly gone through desperate nocturnal conflicts with a single mosquito that has somehow found a hole in the screening and come in to buzz triumphantly first in the left ear and then in the right before settling down to test the blood supply on an exposed shoulder. It is just a test, because the mosquito has already gone when you make the first swat.

I have spent many hours of my life inside large cages with mosquitoes, watching the intimate details of their life, including their individual and collective idiosyncrasies in



A MOSQUITO in the act of laying a raft of eggs on the surface of the water. The larvae of all mosquitoes develop in water



THE RAFT OF EGGS looks like this under strong magnification

biting. I have learned a lot about the character traits of *Anopheles maculipennis* and *Culex pipiens*, but none of this knowledge is of any avail during that midnight struggle. After that first swat, my body tenses in expectation of the next attack. I think I feel a bite and swat again, but a buzz in the ear tells me that the "bite" was probably one of those tricks of sense perception that the psychologists are always fussing with. I decide that the proper course is to let the mosquito settle down and fill up with blood, so that she will go off in a corner somewhere to start the digestive process and stop this silly braggart buzzing.

I try to relax, and presently a series of sensations on one side of the nose informs me that the mosquito has really settled down. I begin to think, why let the brute get away with this? The proboscis, I reflect, is surely well inserted by now and the mosquito sufficiently preoccupied with finding a capillary so that I'll be able to get in a really crushing swat.

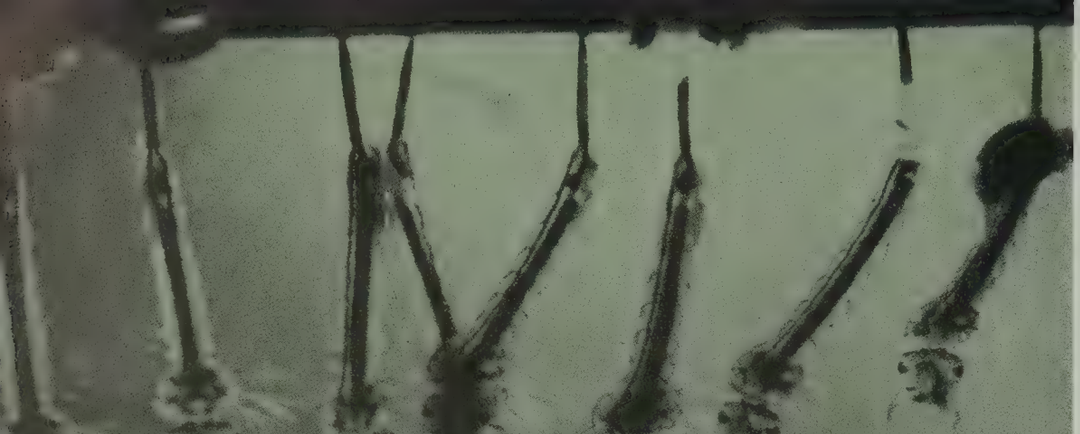
I cautiously remove my arm from under the bedclothes and with infinite patience bring it into position for the blow, which is delivered with speed and precision. I feel my bruised nose to see whether I can detect the squashed mosquito. Nothing. Quite possibly the body fell off onto the sheet. But a minute later I hear that damned buzz again. So I crawl wearily out of bed to get the bottle of dimethylphthalate from the bathroom, and after smearing my face, with due regard for eyebrows and eyes (conditioned from times when I didn't take due regard), I sink back into sleep, though still too mad at the *Culex* to be properly grateful for the chemical accomplishments of modern science.

It is, of course, only the female of the species that bites. Not much is known about the food habits of the males, but they have been caught frequently on flowers, or sucking the easily got-at juices of things like fruits and manure. In Albania, I once tried baiting traps for male mosquitoes with all sorts of substances, and I found that I could catch a few with absorbent cotton moistened with perfume from my wife's dressing table. Cow manure was just about as attractive as the perfume, though.

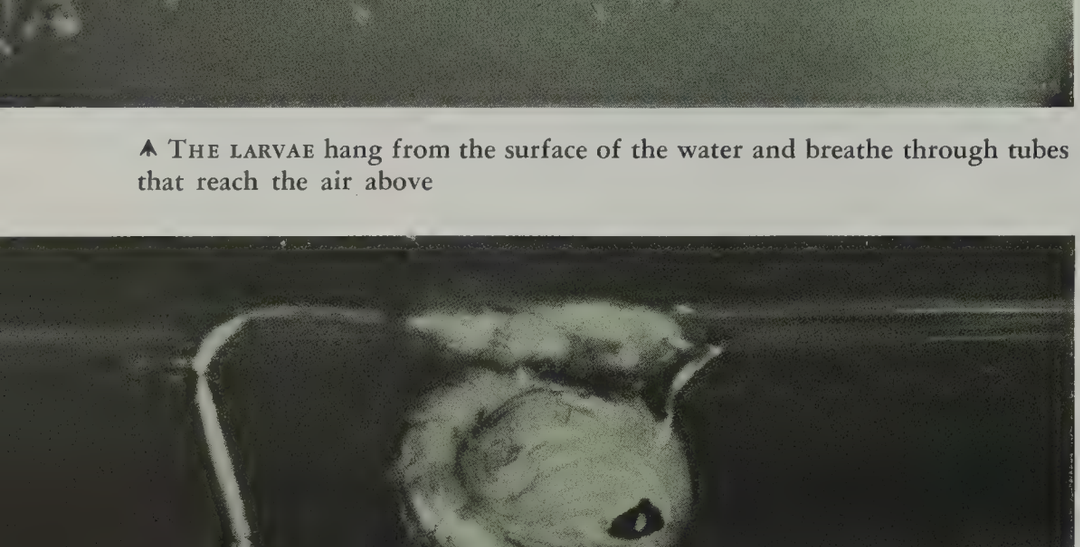
Male mosquitoes are easily distinguished from females because of their conspicuous, feather-like antennae. There are a few records in the scientific literature of attempts

° During his more than 20 years of research, Dr. Bates has enjoyed an unusual variety of field explorations, beginning with several years in Central America and the West Indies. Since 1935, he has been with the Rockefeller Foundation, primarily as a field biologist for the International Health Division—in Albania, Egypt, and Colombia. In Colombia, he headed the Foundation's laboratory for yellow fever research for eight years. He now has a new assignment—the human population problem.

He uses the title of the present article with apologies to Edwin Way Teale, who originated it in a review of Dr. Bates's comprehensive and authoritative book, *The Natural History of Mosquitoes.* His more recent book, *The Nature of Natural History,* is a Natural History Book Club's selection.—ED.



THE LARVAE hang from the surface of the water and breathe through tubes that reach the air above



THE LARVA (*left*) develops into a pupa (*right*). The latter emerges from the larva case, which is seen above it in this view. The creature is still far from resembling an adult mosquito

A CREATURE OF THE WATER transforms into a creature of the air: a female mosquito emerging from the pupa at the surface of the water

at blood sucking on the part of male mosquitoes. When such misguided males have been caught and carefully examined, however, they have always turned out to be hermaphrodites—examples of a queer blending of male and female characters in a manner that is characteristic of insects. One side of the body may be male, the other side female, or the head male, the abdomen female, or something of that sort. These anomalies, called "mosaic gynandromorphs," are possible because sexual characters are determined directly by the hereditary materials of each particular cell, and not indirectly through the action of hormones, as is the case with us and other mammals.

It is the blood-sucking habit of the female mosquito that gives these insects their peculiar importance for man. Not so much because of the annoyance caused to the human blood donor as because of the incidental possibility of transmitting disease. Many of the disease-causing parasites of man circulate in the blood stream, and an insect picking up a sample of this infected blood and later probing some new victim for the next blood meal, provides a fine transportation arrangement—from the point of view of the parasite—for getting from one man to another.

The blood sucking habit must be a very ancient one with mosquitoes. Fossil mosquitoes from the Oligocene, some 40 million years ago, look hardly any different from the mosquitoes of today, and presum-

ably they had the same habits. There has thus been plenty of time for the mosquitoes and the parasites to work out mutually satisfactory arrangements for exploiting the vertebrate blood supply.

As long as mosquitoes were regarded merely as bedroom or picnic nuisances, they were given very little attention by scientists. But with the discovery, at the turn of the century, of their role in the spread of malaria and yellow fever, two of the most widespread and deadly of human diseases, they came in for a great deal of attention indeed. As a result of this study, yellow fever has been brought as completely under control as smallpox. Malaria is still public enemy number one for a large share of mankind, but in many parts of the world it has been eliminated as a health problem, and where it is still rampant, the difficulty is not so much a lack of knowledge as a lack of the funds and organization for the necessary public health measures. In the course of these 50 years of study, we have incidentally learned a great deal about mosquitoes.

▲ Now the mosquito is completely out of the pupa case, which is behind the insect on the surface of the water

▲ EXTREME CLOSE-UP of female mosquito emerging from the pupa

The most recent complete list of the mosquitoes of the world was published in 1932, and at that time 1400 different kinds were known. I once calculated that an average of 40 supposedly new kinds have been described every year since 1932, which would bring the total well above the 2000 mark. But many of the "new" kinds turn out to be mistakes, the new name becoming a synonym of some older name, so that 2000 is probably a safe estimate for the known kinds of mosquitoes in the world.

South America and the Orient have the largest variety, with over 500 species each. About 400 species are known from Africa, and 200 from Australia. North America, with 121 species in the most recent catalogue, and Europe with 125 species, have less variety—but they make up

▲ THE MOSQUITO in the act of drinking human blood. Only the female bites. Most kinds of mosquitoes cannot produce eggs unless they get blood

for this in number of individuals. As one goes north in either hemisphere, there is a steady decrease in the number of different kinds of mosquitoes liable to be encountered, but there is no corresponding decrease in the number of bites. The world's highest mosquito content per cubic foot of air probably occurs somewhere in Alaska or Siberia.

A man who gets caught in a place where there are millions of mosquitoes looking for a source of blood cannot help but wonder what all of these mosquitoes would have done if he hadn't happened along. All of the evidence indicates that most kinds of mosquitoes cannot develop eggs until after they have secured a meal of blood. If a female fails to find a victim, she is doomed to die childless, her function of reproducing the species unfulfilled.

A French scientist, Emile Roubaud, discovered that one variety of the common house mosquito, *Culex pipiens,* can develop eggs without a blood meal. This discovery led to extensive investigations by many scientists, resulting in dozens of learned papers and in the discovery of four other kinds of mosquitoes that can develop eggs without blood. Curiously these particular species that really don't need blood are among the most vicious and bloodthirsty of all mosquitoes. If they can get a blood meal, they lay more eggs than if blood is denied them; but they can be carried along very successfully in the laboratory for many generations with no richer food than apples and raisins.

For the sake of completeness, I had better note here that there are a few groups of mosquitoes in the tropical forests that have taken up more pleasant habits—bright, metallic green and blue fellows that buzz about in the sunshine visiting flowers. A few have acquired very queer habits indeed, like the African and Malayan *Harpagomyia* that station themselves along ant runways and tease the passing ants into giving up honey. The *Harpagomyia* places itself directly in front of an advancing ant, sometimes even nipping the ant between its front legs, and not releasing it until it stops and opens its jaws, when the mosquito thrusts the swollen tip of its proboscis into the ant's mouth and rapidly absorbs the food offered.

But the basic food association of mosquitoes is with blood, and since disease transmission depends on biting habits, these have received particular attention from scientists. Work on biting habits, for instance, has been important in efforts to discover exactly which kinds of mosquitoes are responsible for disease transmission in different places. Laboratory studies show that any species of *Anopheles* can transmit malaria, but in a given place there may be a dozen or so different kinds of *Anopheles* breeding in different sorts of water. To control them all might be impossibly expensive, and it becomes necessary to determine the relative importance of the various species. It usually turns out that only one species is primarily responsible for malaria in a given region, and by learning the habits of this

species, control work can be greatly simplified.

When a mosquito has filled up with blood, she goes off somewhere to digest the meal—a process that takes from two days to a week, depending on the kind of mosquito and on the temperature. She starts with the abdomen red and distended with blood and ends with it distended with eggs. The number of eggs depends on the kind of mosquito, on the amount of blood that she managed to get, and on the kind of blood. Human blood isn't necessarily the best; in one series of experiments, mosquitoes that fed on canaries, guinea pigs, and rabbits produced more eggs per milligram of blood than mosquitoes that fed on men or monkeys. In any case, the eggs are fairly numerous, 100 to 400 being developed per blood meal.

Digestion completed, the mosquito's next problem is egg laying. The larvae of all mosquitoes develop in water—one of the few statements I can make that needs no exceptions or qualifications—so the mosquito must put the eggs in some place where the larvae, when they hatch, will find suitable water. The common domestic *Culex* mosquito finds a rain barrel or puddle, sits on the water surface, and extrudes the eggs one by one, arranging them into a "raft." The eggs are held together by a sticky substance with which they are covered, and the form of the raft is determined by manipulations of the hind legs of the mosquito. Unless disturbed by a water beetle or an inquisitive scientist, the mosquito fixes its whole abdomen-full of eggs into one raft; this finished, it flies off to look for another meal.

The *Anopheles* mosquitoes mostly lay their eggs in ponds, marshes, or areas of quiet water along the margins of lakes. The egg laying is carried out during a sort of hovering dance in which the mosquito bobs up and down over the water surface, dipping down every once in a while to "taste" the water by sticking in a leg (taste buds in insects are mostly on the legs), but otherwise dropping the eggs as she dances along several inches above the water.

Each kind of mosquito has its favored kind of water accumulation for breeding, and some kind of mosquito has learned to utilize almost every imaginable type of breeding place. For the most part, the larvae are closely associated with the water surface, hanging from the surface film and getting air through a tube that breaks the water surface at the tail end of the body. Because of this habit, mosquito larvae are never found in the open water of lakes, where they would merely serve as fish food, or in places where they would be damaged by wave action or water currents. In lakes or large streams, larvae are found in places where they are protected by vegetation; and while many species breed in small, swift streams, their adaptations are to keep out of the current, rather than to resist current action. In such streams, the larvae are found in seepage on gravel bars, in quiet side eddies behind boulders or under waterfalls, and in other places of the sort.

The queerest breeding places are in the tropical forests. In those regions, there are numerous unexpected places in which water accumulates, and every such place seems to have its peculiar species of mosquito larva. I have spent a deal of time in the South American rain forest trying to imagine places where water might occur; if I reasoned correctly and found water, I usually found also some new kind of mosquito.

A very common breeding place is the water that accumulates in rot holes in trees—and such tree holes are used by mosquitoes in the north as well as in the tropics. In South America, the bromeliads—the plants of the pineapple family—provide the habitat of dozens of species of mosquitoes. These plants are epiphytes, living perched on the branches of forest trees, and their long narrow leaves grow out of a water-tight base that forms a structure called a "tank" by botanists. All

▼ The male mosquito is recognized by his feather-like antennae. He feeds on fruit and vegetation and has no proboscis for piercing skin

sorts of debris accumulates in this base, forming a rich infusion that provides the plants with food. It also gives shelter to a whole special fauna of aquatic organisms, including dragon-fly larvae and tadpoles as well as mosquitoes. The leaves of many tropical plants allow water to accumulate at their bases—this is true of banana plants, for instance—and even a thin film of water serves for certain specialized types of mosquitoes. The large upright flowers of some plants collect water, and such flowers also have their special mosquitoes.

The forest fauna that interested me most was that of bamboos. The hollow bamboo stems are often perforated by birds or by boring insects, and whenever a hole has been made into the stem, water accumulates in the internode. Some of these worm holes are very tiny indeed, so that one cannot imagine a mosquito squeezing through; yet when the bamboo is cut open, water and mosquito larvae will be found. These bamboo mosquitoes, we discovered, have very special habits. To breed out adults, we would put the larvae in test tubes plugged with absorbent cotton; but these bamboo mosquitoes, when they hatched in such a tube, would simply wriggle through the cotton plug and thus escape. We couldn't keep them in cages covered with ordinary mosquito-proof screen. A bamboo mosquito, coming across such a screen, would simply stick its head into the mesh and wriggle through, instead of futilely

Photo by Mildred J. Eric

▲ WHERE A STILL DAY means quiet death: a lethal pool on the Upper Terraces at Mammoth Hot Springs, Yellowstone National Park

An INVISIBLE Deathtrap

One of the strangest perils that a bird can encounter

By MILDRED J. ERICSON

AT Yellowstone National Park, mysteries and marvels seem to lie on every hand, but there are few things so startling as a little pool where hundreds of helpless birds meet their doom every year. The innocent-looking little depression, which we may refer to as "Poison Pool," is in the Upper Terraces of the Mammoth Hot Springs formations.

The spot is well shaded and bedded with luxuriant grass, an enticing retreat for any unwary member of the feathered clan that sto for a refreshing drink or bath. T water is safe enough to drink, b death lurks in the carbon-dioxi gas that continually bubbles to t

face. On still days the area is a cuum of death. Since the carbon-xide gas is heavier than air, it n increases its concentration to h an extent that the rapid res-atory systems of its victims are ercome and they drop to a rest-place on the ground.

I am certain that these birds do t always lose their lives on the t trip, because wind sometimes eps the area well ventilated and e. Sooner or later, however, the ds remain too long on the wrong y.

The number of victims varies ac-rding to atmospheric conditions, d the kinds that are overcome em to depend on the concentra-n of the gas. On two different irs, I counted 26 birds around the ol's edge, though the daily toll seldom this large. The birds range om a screech owl found one day, wn through the small flycatchers d warblers. Songsters that met eir fate here include the evening d pine grosbeaks, green-tailed whee, western robin, pine siskin, estern tanager, white-crowned d chipping sparrows, Audubon's d pileolated warblers, mountain ickadee, red-breasted nuthatch, estern bluebird, hairy woodpecker, estern flycatcher, and Clark's nut-acker.

No one knows how many birds e here every summer—probably ndreds. An accurate count can-t be made, because animals visit e area at night and feed upon the all feathered victims. Coyotes, martens, and weasels make this their evening dining room, and their diet depends upon nature's fickle mood. Each morning, park ranger-naturalists note that some victims of the previous day are missing and that new ones have been added.

Apparently four-footed animals are seldom if ever suffocated by the gas, presumably because they are not so susceptible to impure air. It will be recalled that canaries have long been taken into mines to detect the presence of poisonous gases. In other portions of Yellowstone Park, animals the size of bears and elk are reported to have been killed similarly, according to observations in 1888 and 1897.* However, David de L. Condon, the Chief Park Naturalist, expresses some doubt about this. He informs me that he has on three occasions visited Death Gulch, where the reports originated, to search for the carcasses of animals killed by the gases from the solfatara vents. But he never found any and is inclined to believe that adverse winter conditions may have killed the large animals found there. In fact, he thinks that the calcite springs area below Bumpus Butte might be far more dangerous than Death Gulch.

Be that as it may, "Poison Pool" takes its toll of birds whenever conditions are right, and surely it is one of the most unusual dangers that they could ever encounter.

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*Science, Feb. 15, 1889; *Science Monthly*, Feb., 1899.

bumping against the screen like an ordinary mosquito.

The growth rate of a larval mosquito varies greatly according to the habits of the species. Those that breed in temporary rain pools sometimes grow very fast indeed, passing from egg to adult in the three or four days that elapse before the pool dries up. Others, that live in protected situations like tree holes, may take many months to grow up.

I have often been asked, "How long does a mosquito live?" Meaning, of course, an adult mosquito. The answer is, "It depends." In Europe and North America, many kinds of mosquitoes pass the winter as adults, hibernating in outbuildings, in caves, or in tree holes. With such mosquitoes, the last blood meal of the fall turns into a fat reserve instead of into eggs, and the adults live for many months in an inactive state.

The conditions of life for such a hibernating mosquito are very different from those for an active mosquito engaged in its proper business of annoying picnic parties. The hazards of existence for an active mosquito must be tremendous, and probably few of them manage to live for more than a few days. Yet to transmit malaria or yellow fever, we know that a mosquito must live for at least a week or two, to complete the incubation period of the parasite. Since these diseases are, or have been, very common, a great many mosquitoes must survive for this incubation period.

I have often wondered how it happens that anyone ever gets malaria, considering all of the hazards of the mosquito transmission cycle. Yet we are sure that we know all of the essential facts about malaria transmission; and millions of people get the disease every year, so the system of transmission would have to be called "successful."

In the United States, to be sure, this transmission system may already have met complete defeat. At a meeting of malaria experts held late in 1949, the specialists were asked how many new cases they had seen during the year among persons living in the United States. Only four new cases were described, although of course there were numerous cases of relapses, or of infections acquired abroad. Not many years ago there were millions of new cases of malaria in the United States every year.

Thus we seem to have the basic information that is necessary for the control of the disease, and in regions with well-developed public health services, malaria is on the way to becoming a medical curiosity. In India, Africa, and much of tropical America, it is still the major human disease, but the need is mostly for expanded public health organization. But even with malaria removed from the face of the earth, mosquitoes would still be valuable and interesting subjects for study, perhaps giving us clues to the general problems that seem to be just beyond our understanding: problems of the adaptations and mutual relations of our fellow organisms, and of the method and direction of the evolution of species.

IS AMERICAN INDIAN CULTURE ASIATIC?

Continued from page 351

to this question that have caused most anthropologists to think of the American Indian civilizations as having developed independently.

We must discard, first of all, the land bridges or large islands that have been supposed by some to have existed in the Pacific or Atlantic oceans and to have been routes of migration into the Americas. Geologists and oceanographers are in general agreement that the great ocean basins were never land areas—certainly not during the relatively late geologic periods of man's existence. It seems we must think of any trans-Pacific contacts as having taken place by boat.

The Polynesians in their great sailing canoes were able to cover vast areas of the Pacific and probably did, on occasion, reach American shores. However, our survey of Old and New World parallels has indicated contacts more with continental Asia than with the Pacific Islands. I doubt, therefore, that the latter should be considered as a necessary intermediate step in the diffusion or transport of cultural ideas across the Pacific.

I would look rather toward mainland southeastern Asia, where we have reason to believe that shipbuilding and navigational techniques were well advanced at an early date. Accounts from the second to the fourth centuries of our era record the existence of ships that must have been larger than those of Columbus and other early Spanish explorers, and they were sailed considerable distances, from India to Java and China. Whether or not they could have made the much longer voyages necessary to have reached American shores is another of our problems needing careful investigation.

We have been asking many questions, but that is about all we can do at the present time in regard to the problems of trans-Pacific cultural contacts. We strongly believe that the questions are valid ones and have implications of supreme importance in the scientific study of man's history. They are questions needing more consideration and discussion than have been given them in the past, but we can feel confident that unbiased investigations will lead us surely, though perhaps slowly, to reliable and fairly complete answers.

THE SIGNS COLUMBUS FOLLOWED

Continued from page 365

found at once, small pieces in the noses of Lucayan Indians, gold the Indians told them had come from the islands of the south. So south they went.

Columbus followed the gold and took the gold as a sign. But the broader spirit of the man still shows in his constant delight at the varied and beautiful colors of the coral reef fishes and in his interest in the parrots, lizards, and flowers of the islands, in coconut palms and coconut crabs. Finally he came within sight of Cuba, which he took to be Japan itself, and he resolved to go from there to the Asiatic mainland to deliver in person the Royal Letters to the Grand Khan. On the first day of November he landed, together with his company. For a full month they explored and sailed about the island finding no sophisticated civilization and little sign of gold. Gradually they came to realize that Cuba was not Japan, and Columbus looked upon it more for what it was—a large and lovely island inhabited by ignorant but gentle Indians who lived by simple methods of fishing and agriculture.

After the shipwreck, Columbus became decidedly uneasy. Martin Alonzo Pinzon had already deserted in the "Pinta" in November, and Columbus was uncertain of his own authority on the "Nina," which had Martin Alonzo's brother as captain. When the "Pinta" rejoined the "Nina" early in January, he decided the sooner they set sail for Spain the better. So the ships worked eastward along the north coast of Hispaniola, and it was during these last few days that Columbus saw the three mermaids "which rose well out of the sea . . . not so beautiful as they are painted, though to some extent they have the form of a human face." It is recorded that the Admiral had seen some previously in Guinea on the coast of Manequata, and he announced on this night, in the name of our Lord, that he would set out on his homeward voyage without any further delay whatever, for he had found what he sought.

It is difficult to say what the mermaids meant to him, though his immediate decision to sail for home suggests that they were the last straw. What he saw were the manatees or sea cows of the Caribbean Sea and great South American rivers. What he had seen off the reed-fringed tropical coast of Africa were their close cousins, the dugongs. Sea cows do look half human as they raise their head and chest out of the water to look around. They are, in fact, warm-blooded mammals that breathe air and bring forth their young alive; and the round head, the arm and hand clasping a suckling youngster to the breast, inevitably suggest the idea of mermaids.

So the two caravels set forth on the long voyage home, striking boldly to the northeast, a course that took them directly to the Azores. There is the same day-by-day record of man-o'-wars and boobies, tropic birds and weed, for the Sargasso Sea still lay between. By the end of January food was running low, and it was fortunate that the sailors caught a very large shark (probably a Basking Shark), "which was very welcome, as they now had nothing else but bread and wine, and some yams from the Indies."

Then, on the fourteenth day of February, the day before the Azores were sighted, the caravels were caught in a great storm. During the night of the thirteenth the ships had lain-to in a high and tempestuous sea, and they sailed close-reefed all the next day. Then the "Pinta" ran before the wind, and only the Ad-

miral kept to his course. It was this storm that brought to his mind the recollection of the trees he had seen growing "even within the sea." These were the mangroves of the tropical islands, with their roots in the sea, and he interpreted their peculiar growth to mean that there could be no great storms in the countries he had discovered. At this time he had not experienced a hurricane, which mangroves withstand well.

Such were the signs. Most of them were meaningless or false, yet they served. For it is not the men of action who make the greatest discoveries. The dreamer who becomes a visionary and is stirred finally to set out in search of the Holy Grail goes farther into the unknown and returns richer than the professional, who often knows even too much to start. The signs served Christopher Columbus and upheld his faith to sail on and on into the path of the setting sun, telling him, as he himself had told the Spaniards, that India lay to the west as well as to the east. The signs also whispered to his secret heart that he would find the lost Eden, the Earthly Paradise. But that is another story.

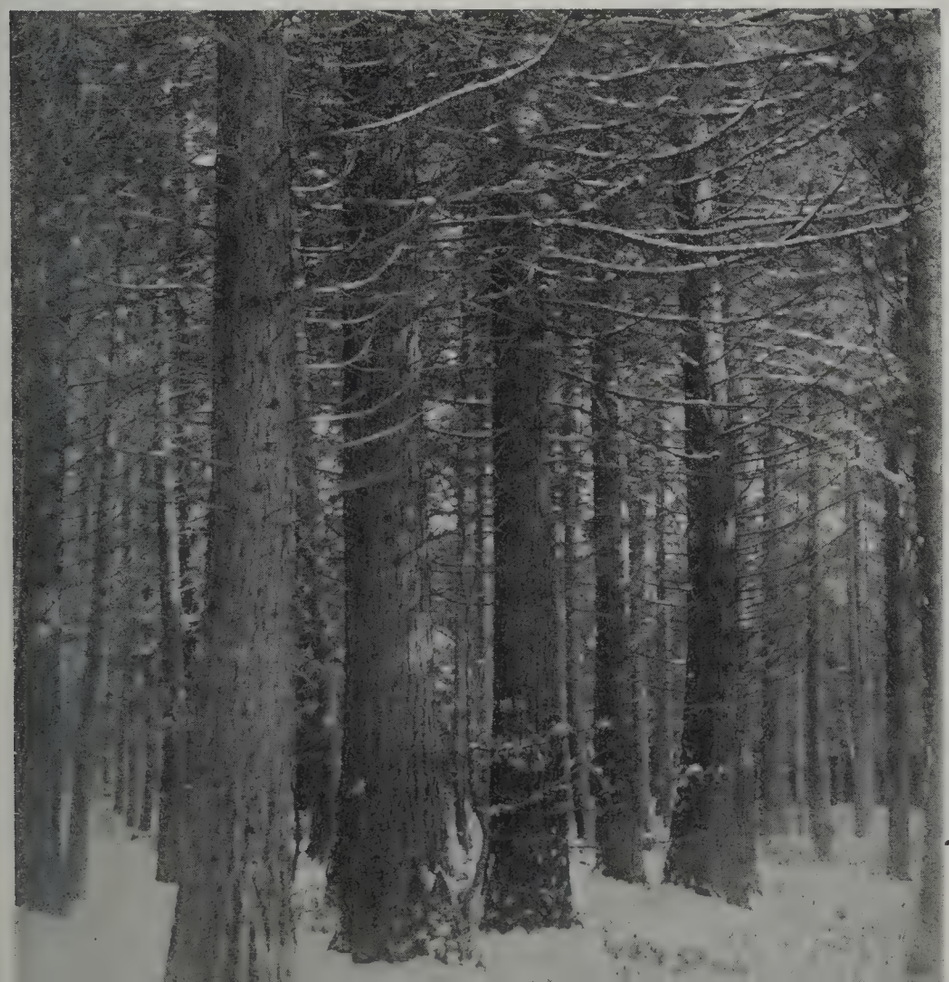
Sequoias Colonize Britain

By John D. U. Ward

CALIFORNIA gold has made its mark on the English countryside and on thousands of parks and gardens throughout the British Isles. The search for gold took men among the Sequoias, and it was between 1846 and 1853 that seeds of both the Giant Sequoia (*Sequoia gigantea*) and the Redwood (*Sequoia sempervirens*) were sent to Britain for the first time. According to one story, the first parcel was sent in a snuff box by transcontinental Pony Express, the mail charge being $25 for 2 ounces.

There was some international disagreement about the name of the Giant Sequoia, for each country wished to honor its national hero. Americans said the tree should be Washingtonia, but the English said that in England it would be Wellingtonia—and it still is! Foresters and botanists refused to squabble: for them *Sequoia gigantea* was good enough, and the tree may now be seen nearly everywhere in Britain. Already there are specimens exceeding 125 feet in height, but unfortunately in Britain the timber is not good enough for the tree to be valuable in forestry.

The famous redwood, *Sequoia sempervirens* is less widely grown as an amenity tree, but British foresters value it much more highly. The heaviest stand of timber in all Britain is a redwood grove, not yet 100 years old. One tree, which cannot be more than 103 years old, has already exceeded 150 feet in height. As the redwood seems to grow quite as well in Britain as in California, our successors may see in Britain trees as tall as any in the world.



▲ A Giant Sequoia growing in an English garden. In the background is an incense cedar

◀ Thirty-five-year-old Big Trees in Berkshire, with a gigantic future ahead of them. Century-old Sequoias in Britain are over 125 feet tall

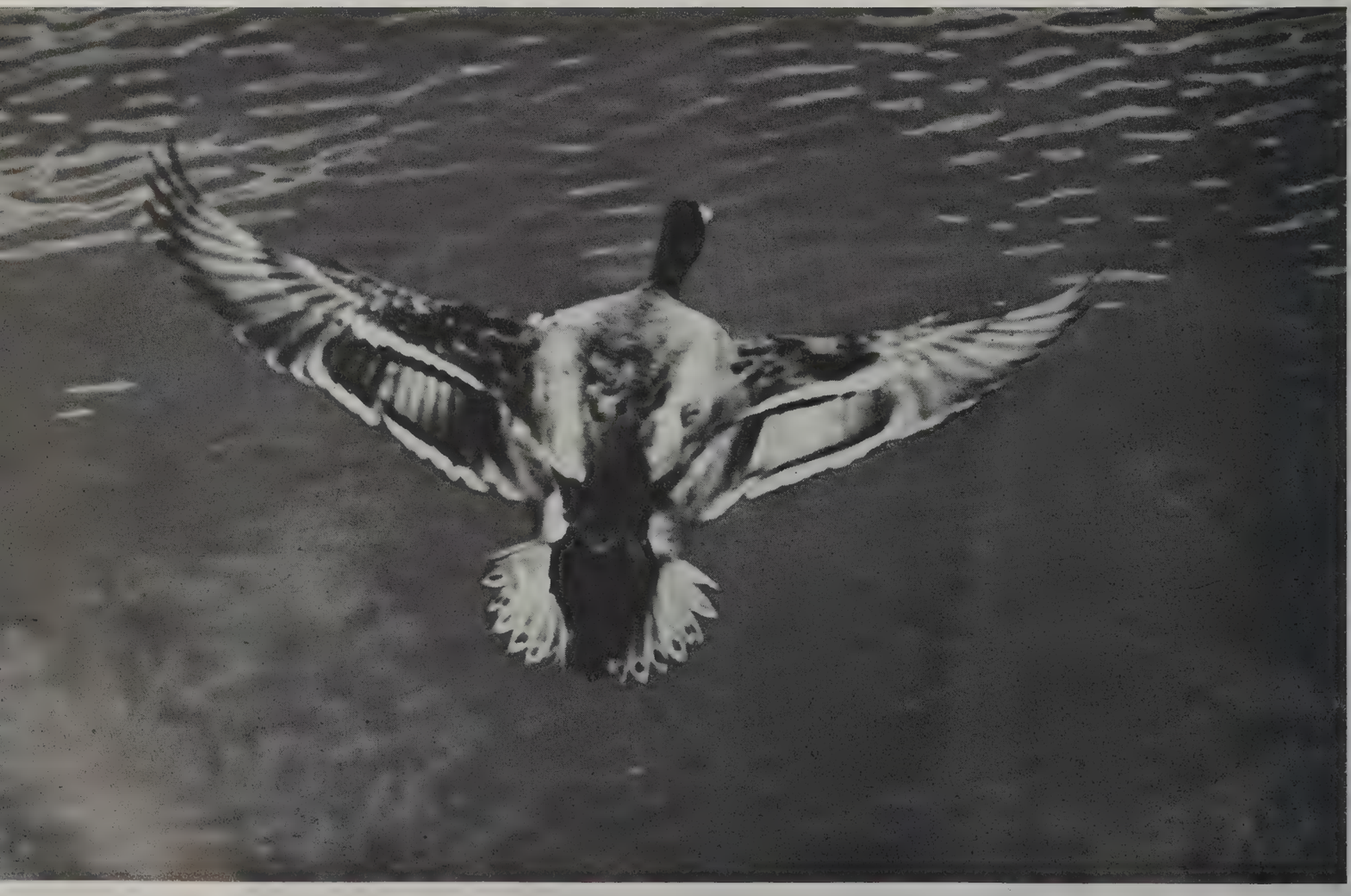
 Continued from page 338

species but here, again, the limits are relatively fixed for each sex.

One possible reason for the nonsurvival of a dwarf bird that might be hatched is the competition of nestlings for the food brought by their parents. An undersized individual could easily fail to receive its proper share. Something of the sort occurs among birds like the owls, where incubation may start when the first egg is laid, resulting in the hatching of the first eggs some time before the later ones. The late-hatched nestlings are, of course, behind their older brothers and sisters in growth and vigor, and in case of unfavorable conditions such as a shortage of food supply, severe storms, or other misfortunes, they often succumb while the stronger individuals survive. If they grow to maturity, however, they are as large as their nest mates. A bulky young cowbird in a nest of baby warblers gives the rightful infants little chance for survival.

"Runt" eggs are not uncommon, but they are abnormal products and probably never hatch. They appear to consist entirely of albumen and shell without the vital yolk, and hence are incapable of hatching. Even if one were to be complete, it is not at all certain that it would produce a dwarf bird.

MALE MALLARDS in flight: action photographs taken by Hugo H. Schroder at 1/1000 second



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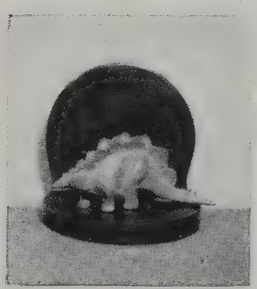

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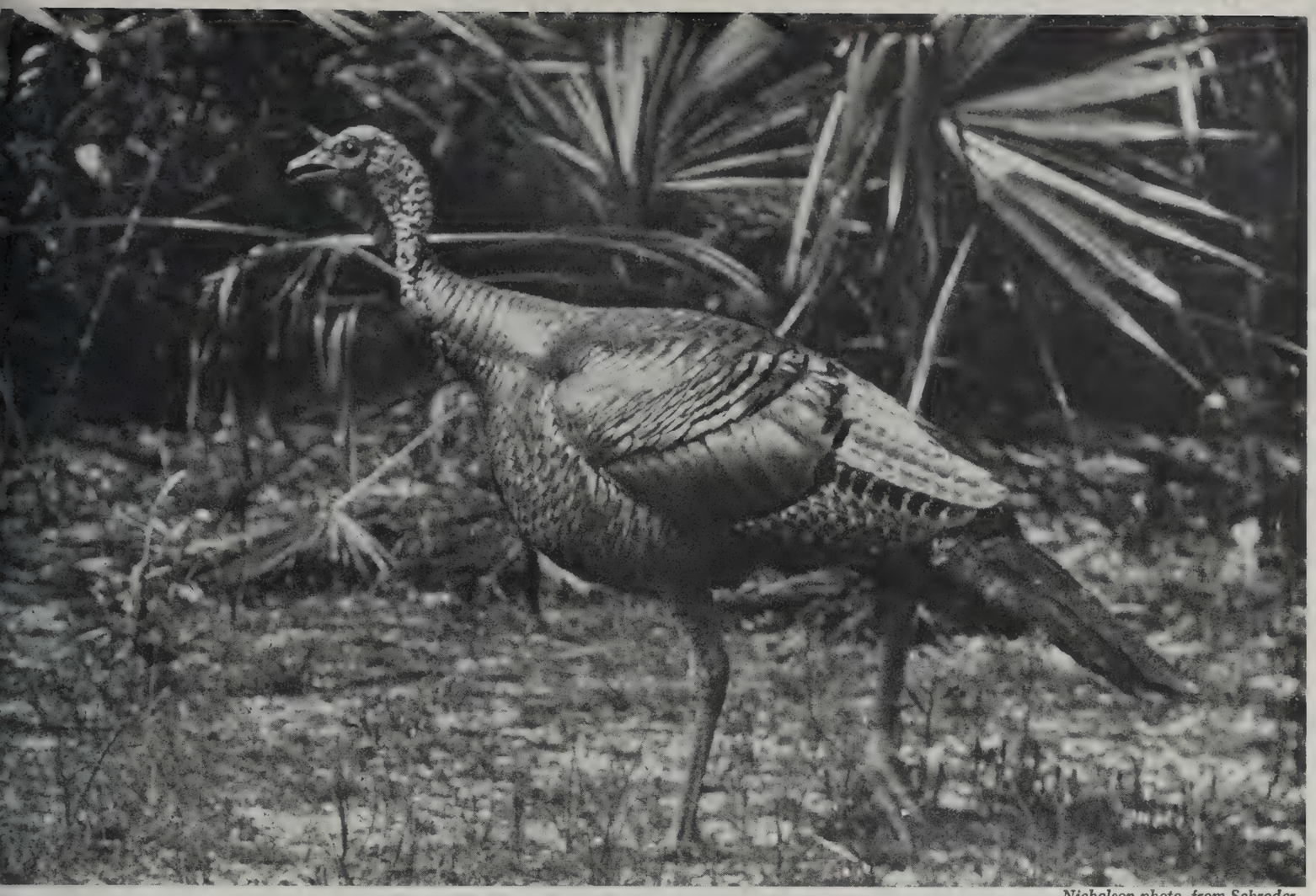

Nicholson photo, from Schroder

A WILD FLORIDA TURKEY, whose "grand uncles" traveled to Europe and back to America to become the Thanksgiving Day symbol

The Turkey—a Bird with a Baffling Name

By JOHN T. ZIMMER

Curator, Department of Birds
American Museum of Natural History

WHEN the early colonists reached the eastern shores of North America, they found an abundance of one bird that they had known as a barnyard fowl in their homeland. In fact, it is quite probable that they brought some of the birds with them. This was the turkey, one of the most characteristic birds of North America and one that Benjamin Franklin later thought should be made the national emblem of the United States in place of the Bald Eagle.

The Spaniards, as early as 1517, found the turkey already domesticated by the Aztecs and took it back to Spain, from which country it was carried to other European areas. The domestic birds were somewhat different from those the English colonists found on the eastern seaboard, having the feathers of the lower back and tail tipped with white instead of rich chestnut-brown, thereby proclaiming their Mexican origin. Local birds may have been caught and tamed, and some barnyard individuals undoubtedly escaped to the woods, so the populations eventually became somewhat mixed in the neighborhood of settlements. The distinctions are still evident, however, though the wild birds have been extirpated over much of their once-extensive range. Several intermediate forms or subspecies occur in the Southwest, and still another lives in southern Florida — somewhat smaller than the northern bird with narrower barring on the wings (see illustration). Various domestic strains have been developed that differ widely from the original stock, and there is a quite distinct species in southern Mexico and adjacent countries, the handsome Ocellated Turkey.

Much has been written about this fine bird, but one question is still uncertain: Where did it get its name? One suggestion has been that it was long confused with the guinea fowl, which may have reached Europe from Africa by way of Turkey and was once known as the Turkey-cock. When the two birds were eventually recognized as distinct (their confusion seems hardly credible), the name turkey was retained for the wrong bird as, indeed, its Latin name *Meleagris* was undoubtedly misapplied. Another account credits the bird with having named itself by its repeated call of "turk-turk-turk—." Which answer is correct, if either, remains a matter for speculation.

LETTERS

A Persistent Tree

SIRS:

The adjoining photograph shows what happened when a growing tree found a heavy wire gate in its path. The gate had been leaning against a fence for several years, and the tree grew up through it. New construction work made it necessary to cut down the tree, and we were interested to see that the shoots had grown directly through and around the wires, as is shown here.

H. A. RICHARDSON

New York, N. Y.

Geese in Trees

SIRS:

An old pioneer of Clark Fork Valley told me something I could scarcely believe, though the gentleman was well reputed for his honesty. He had . . . lived in the first homestead at Clark Fork, Idaho, and had been a continuous resident of the area since 1883. He said that he had seen geese by the thousands roosting in the trees along Clark Fork River. "One day not many years ago," he told me, "when I went into a store in Hope, an old fellow had just been telling how geese roosted in the trees. No one believed him, so when I came in, he asked me to verify it. I told them that I had seen geese in the trees and that I wouldn't have believed it either if I hadn't seen them myself." My informant did not know why they did this but suggested that, since geese are smart, they may have done so to get above the ground to avoid mink and other animals that prey upon them. Sometimes, he said, they lived in eagles' nests, too. The gander would take possession of an eagle's nest and often fight for two or three days. The gander usually won out when he had plucked out enough feathers; and the eagle never seemed to return. He also said that when the goslings were hatched, the parent geese would fly down to the water with them in their beaks.

Can you give me some enlightenment on these points?

MRS. SUNNIE F. LANCASTER

Opportunity, Wash.

The following remarks are offered by Dr. John T. Zimmer of the American Museum's Bird Department:

It has been reported that the Canada goose sometimes takes to the trees in certain parts of its range and on occasion makes use of the nests of some of the larger birds of prey. Osprey nests, in particular, have been spoken of in this connection. The reports have not been sufficiently numerous or detailed to mention all the kinds of nests that may have been used in this way, but I see no reason why those of the golden and bald eagle might not be on the list.

No reports have come to hand regarding conflicts between the geese and the rightful owners of the pre-empted nests. The nearest approach to information on this aspect of the situation comes in a report of an osprey nest that was found to contain two osprey eggs and three goose eggs. Ospreys and geese were both near by when the observer examined the nest and collected all but one goose egg, and they both resented the intrusion. Later, the single goose egg remained in the nest with the osprey incubating it, and the geese were nowhere to be seen. This would seem to imply that the geese had been the losers.

The Canada goose is a good fighter on the ground, but it might be at some disadvantage in a tree, even with the added foot space given by a nest platform. I am not sure that I am prepared to accept the account of a successful treetop battle with an eagle—a bird of no mean power itself, and certainly more at home in the environment. Such a conflict might possibly turn out as described, especially if the goose had already started incubation and the eagle was only preparing to occupy the nest; but it is doubtful if this is a regular occurrence.

When geese nest in trees, the young are not carried down by the parents but are pushed out of the nest to flutter down by themselves in the manner adopted by various tree-nesting ducks.

Why the birds take to the trees is not always clear, but it has been suggested that some of the localities where this occurs are subject to spring freshets that would wash away a nest placed on the ground. That is one possible answer to the question.

Stolen: One Fish

SIRS:

I have fished for brook trout for many years and fully understand the "hazards," such as trees, shrubs, grass, stumps, and wind. The following incident is something new in my experience. While Harry H. Miller of Burlington, Vermont, was fishing one evening in July at the Lake Mansfield Trout Club, he was about to net a trout, estimated by two experts to weigh ten pounds, when a barred owl swooped down and took the fish from the mouth of the net. A few feet above the water the hook was released, and the owl headed for the woods. It was known that a family of young owls lived near by, and it is assumed that the youngsters enjoyed a treat.

J. M. HOLLISTER

Stowe, Vt.

Dr. Dean Amadon, of the American Museum's Bird Department, expresses the opinion that, though this must have been an unusually bold bird, it should not be taken as any great surprise that a Barred Owl should swoop down and seize a trout that was being netted.

"The Barred Owl," he remarks, "is more partial to swamps and tree-fringed water

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

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VOLUME LIX—No. 9 **NOVEMBER, 1950**

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From a color photograph by W. Bryant Tyrrell

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The Prothonotary Warbler

One of the handsomest of the family of Wood Warblers is the Prothonotary Warbler, shown on this month's cover in a color photograph by W. Bryant Tyrrell. It has no striking pattern of contrasting colors like some of its relatives, but its brilliant orange-yellow head and underparts need no such enhancement. The origin of the bird's name is lost in mystery, having been given to it by Buffon in 1778 without explanation. Possibly it had some connotation of the saffron robe worn by a contemporary church or court official, but the allusion has never been traced.

The bird is a lover of swampy woodlands in the eastern United States, building its nest in hollow stubs over the water, often in the abandoned hole of the downy woodpecker or chickadee. The nests are lined with moss or other soft plant fibers. Usually from five to seven eggs are laid, of a creamy-white or buff color, heavily marked with chestnut-red or purplish spots.

The male's song is simple but loud and clear, and, in addition, he is said to have a softer utterance given only in flight during the nesting season.

John T. Zimmer

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- - - - - - - - - - - - by A. d'Abro

Dover Publications, Inc., $3.95
481 pp., 21 figs., 15 plates

THIS book, outlining the development of thought from the theories of Newton to those of Einstein, calls for deliberate and careful reading because it epitomizes the profoundest depths of rationalization reached by man. Although the frontiers of advanced scientific thought lie beyond the perceptive powers of the average reader, the author has kept his text as simple as the subject permits and selected examples most likely to be grasped by a lay reader.

The desire of the public to venture beyond the confines of every-day thought into the mysteries of the Smyth report indicates the need for a book such as this. The more one reads along these lines, the more one marvels at the ingenuity and logic displayed by the master minds of science.

Most of our worldly affairs, and most of this generation's academic background, are conditioned upon acceptance of the theories of Euclid and of Newton. For terrestrial phenomena and for most of man's behavior these theories have worked well. For an atomic age something new has been added, and d'Abro tells us of the steps by which a select few have struck out along new lines of thought. We are told that psychologically man is incapable of grasping the full significance of some of these postulates. To that this reviewer might add that an occasional mental barrier may crop up for the average reader. But as I mounted each new theory as it broke from the corral of common experience I felt a challenge to ride it as long as possible. Intrigued by the daring departure from accepted truth, I took the curves as long as possible, and even if I was flung off into the infinite I intend to go back and start afresh from time to time.

It seems to me that this book will grow on one, that each new study will reveal things not mastered at the first reading. After all, the ideas set forth are the products of centuries of thought. How nice it is to have this boiled down in one volume.

HAROLD E. ANTHONY

A NATURALIST IN THE GRAN CHACO

- - - - - - - - Sir John Graham Kerr

Cambridge Univ. Press: London and New York, $4.50, 235 pp., 25 illusts.

IN this book John G. Kerr tells the story of his two natural history expeditions to the Paraguayan Chaco. The first trip took him in 1890 up the Bermejo and Pilcomayo Rivers—especially the latter, where he became the good friend of the "wood-age" Natokoi tribe of Indians.

The second expedition (1896) led him with his close friend J. S. Badgett, up the Riacho Negro west of Concepción to a mission called Waikthlatingmayalwa, in search of the South American lungfish *Lepidosiren*. They were eminently successful and obtained *Lepidosiren* material in practically all stages of development by collecting in the deep grass swamps around the station.

The Pilcomayo expedition was much the more hazardous, partly because of continuing dissension between members of the expedition, partly because, due to the drying up of the river, boat travel was much delayed and supplies of food ran very low, and partly because, all unknown to him, Kerr was continuously stalked and watched by the Indians as he pursued his work of collecting animals and plants ashore. It was this very watching, however, that in the end assured the Indians that he was a mere naturalist and led them to give him their friendship and trust.

The book is packed with valuable but random jottings on the behavior of the animals, birds, reptiles, and amphibians seen by Kerr, virtually all referred to by their technical as well as colloquial names. This latter fact makes me wish that the author had seen fit to add a technical index, for among naturalists few know that the Indian name for the maned wolf, *Canis jubatus*, is *Aguará guazú* (index, p. 234).

The chapter on the Natokoi is particularly interesting. Kerr lived with them in their camps and was thus especially well placed to observe them.

The "60-foot poisonous serpent" *Bothrodon pridii*, with fangs (plate 8) four or five times as long as those of a rattle-

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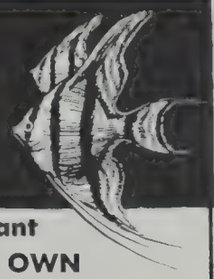

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Duff

By William Marshall Rush

An informative story of a black bear with superb illustrations by a former member of the Museum staff. The description of the country, the details of bear life and character, as well as much humor add to the interest of this appealing story. Ages 11-15. 244 pages. *$2.25 plus .06 postage.*

The BOOK SHOP

THE AMERICAN MUSEUM OF NATURAL HISTORY

77th STREET AND CENTRAL PARK WEST, NEW YORK 24, N. Y.

snake, is not so. C. M. Bogert, Curator of Herpetology, tells me that the tooth in question, of which there is a cast in this museum's collection, is positively not that of a reptile. It may be the tooth of some species of extinct fish.

I greatly enjoyed reading this book. It is simply told and utterly convincing. Perhaps the saddest part of it all (to a museum man) is the fact that the large collections made on the Pilcomayo and left on board the "Bolivia" to be brought out later, disappeared and were never seen again.

G. H. H. TATE

THE BIRDS OF GREENLAND

- - - - - Text by Finn Salomonsen
Drawings by Gitz-Johansen

Vol. I, Ejnar Munksgaard,
Copenhagen, Denmark, $9.00
157 pp., 17 illusts.

THIS volume of 157 pages, 17 plates, and numerous decorative drawings is the beginning of a bibliophile's treasure. It is published with the support of the Danish Government, and in sumptuousness it harks back to the lavish days of Prince Bonaparte and John Gould. There the resemblance ends, because its text is that of a modern regional survey, and its art strikes a completely new note.

The creators are both Danes who have had long experience in Greenland, and their product springs from fullness of knowledge. The artist, for example, sketched birds and landscape for seventeen years all over Denmark's vast arctic colony—sixty times larger than the home country—before he had an inkling that his work would be put to its present end.

The text appears in both Danish and English, running in parallel columns. Dr. Salomonsen, whose competent use of our idiom is already well known to his colleagues, first wrote the English account and afterwards prepared a free translation into his own tongue. The life histories, headed by the Danish, English, Eskimo, and technical names, treat the waterfowl included in this first of three volumes strictly in terms of their Greenland status. They readably cover the description, range, seasonal movements, feeding and breeding habits, and relation to the aboriginal human inhabitants, together with occasional discussion of ecological or other biological problems. Typical biographies fill (bilingually) from three to eight or ten large pages. They deserve more critical consideration than can be here allotted because of the need to discuss the illustrations.

Ornithologists, whose ideas of bird portraiture are mostly conditioned to stodginess, will probably give none too warm a welcome to Mr. Gitz-Johansen's plates. Therefore, it is timely to say that they represent a noble departure from precedent.

Much more than a century ago, a genius named Audubon, who had received academic training under the French master, David, began to paint the birds of America. Since his time, most illustrators of birds have been at best content to be Audubon imitators, contributing nothing new and in countless instances departing further and further from sound canons by puddling with the muddy pigments of so-called tempora. They have produced thousands of "pretty," gutless pictures that stir no inward flame. Despite such patent degeneration, there are ornithologists who fly in the face of all adequate artistic judgment by condescendingly speaking of Audubon as "a good bird painter for his day!"

Now, Gitz-Johansen is neither Audubon nor a "me too." He has blazed his own trail in the milieu of free, clean, rich, and strong water color, and his impressions of birds will make nobody yawn. True, the plates are not all equally successful; the Greenland mallard, for instance, does not please this reviewer. But the loon, the fulmar, most of the geese, the Barrow's golden-eye, and others are magnificent. If you have any doubt about it, stack them up beside the illustrations in recent American bird books and see which portraits represent the living fowl in its ambiance of land and sea and sky.

R. C. MURPHY

Continued on page 432

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Menaboni's Birds
BY ATHOS AND SARA MENABONI

U. S. Army photo

THE AUTHOR (*left*) and K. Maedo, ... inspector. On this unique expedi... 22 whales were weighed in 3 months

▲ A WHALE is hoisted up the skidway in the stern of the 10,000-ton factory ship. Note the chunks of ice floating in the antarctic waters

The Largest Whale Ever Weighed

A thrilling whaling expedition into antarctic waters accomplishes, for the first time in history, the mammoth task of weighing on shipboard the giant among mammals

By LT. COL. WALDON C. WINSTON

Photographs by the author unless otherwise credited

THIS is the story of the weighing of the largest whale ever weighed—an event that I personally witnessed for a four-hour period during which I kept notes as fast as chilled fingers could write. It is my impression that such a laborious event has scarcely been undertaken since Jonah's time.

The First Fleet of the 1947-48 Japanese Antarctic Whaling Expedition was unique for breaking precedent and accomplishing the unusual in whaling. There was nothing outstandingly different about the appearance of the twelve-ship fleet—a factory ship, two processing ships for salting and refrigeration, two cold-storage ships, six catcher boats, and an oil tanker—totaling 45,000 tons, except that from its mast waved the International "E" (Easy Flag, modified) authorized by the Supreme Commander for Allied Powers (SCAP), General Douglas MacArthur. Beyond its own territorial waters, no other nautical flag was authorized to occupied Japan. Personnel of the First Fleet aggregated 1300 Japanese, two Allied observers, one an Australian and the other a Norwegian, plus one American, the present writer.

My presence with the expedition was the result of a latent interest in whaling. On June 21, 1947, when I learned of plans for a second post-surrender whaling expedition for Japan, I volunteered as General MacArthur's personal representative in charge of the First Fleet. I was a member of the Natural Resources Section, GHQ. My qualifications were that I volunteered "irrevocably."

My job was to observe Japanese compliance with International Whaling Regulations and directives

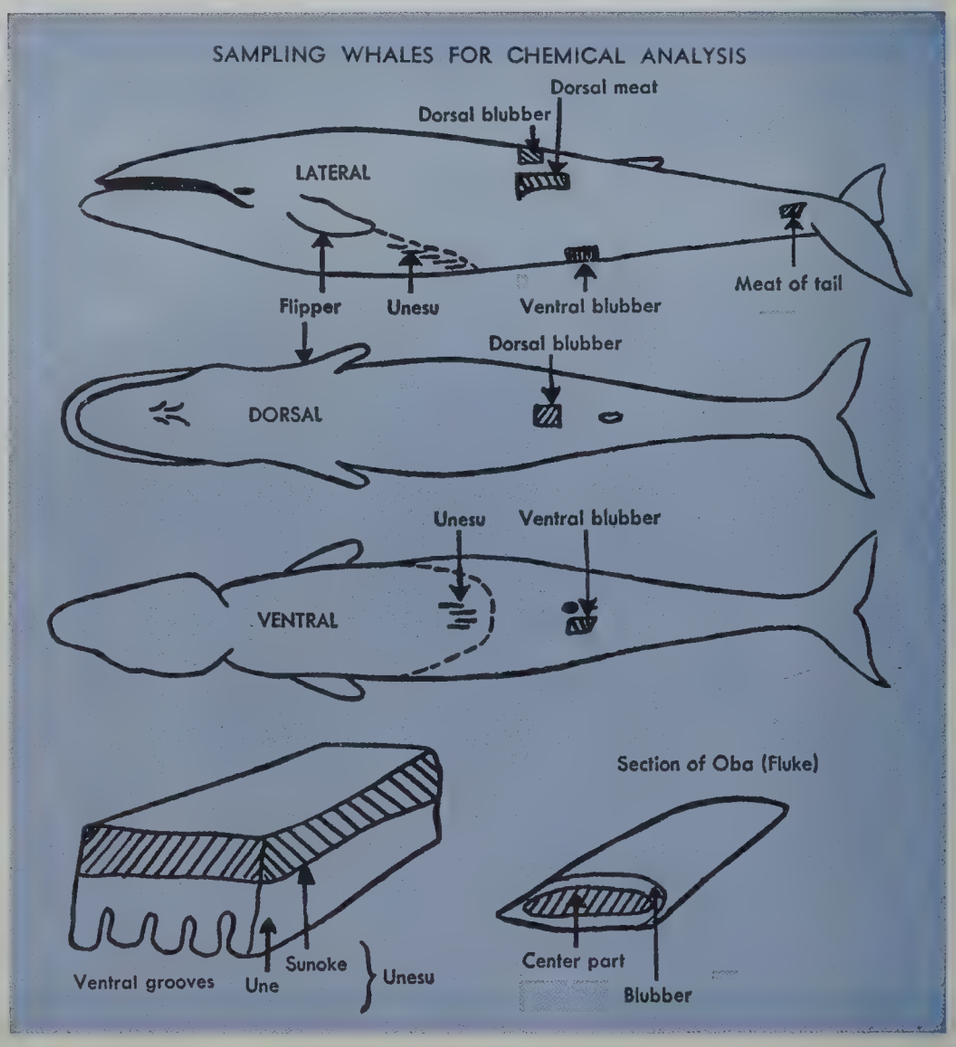
THREE-TON TONGUE (seen from over... is being cut away from the twenty-...oot lower jawbone. What appears to ...rlike growth is actually whalebone ... which serve as a sieve. Scattered ... plates are part of an unswallowed ...f "krill," a small shrimp (*Euphausia* ...)

▲ WORKMEN STAND about an 80-foot blue whale caught in the Ross Sea about 250 miles from Little America. The whale has been turned on its belly, giving a clear view of its scooplike mouth and of the lower jaw, which juts out beyond the snout

issued by SCAP and to ensure efficiency of operation.

For the first time in my life, I read *Moby Dick* and any other books I could find on whaling. Before leaving Osaka I learned from Japanese biologists, whaling company officials, and experienced whalers that never in the history of whaling had a whale been weighed aboard ship. I resolved that we should accomplish this, and we did so, not once but 27 times during three months of actual operation in the fog-bound, iceberg-infested waters of the Antarctic Basin and the Ross Sea.

Our 6000-mile route to the whaling grounds reversed the island-stepping approach to Japan that led up to V-J Day. Soon after leaving Japan, bloody Iwo appeared off our port, followed by Saipan, Truk, Bougainville, New Britain, and the Coral Sea. We then cruised off the east coast of Australia and into the Tasman Sea and Indian Ocean, and entered the whaling grounds near the Balleny Islands. On the 5th



of December we killed two sperm whales.

The antarctic season on blue and finback whales, in which we were most interested for their meat and oil, began on December 8. Our hunting took us across the Antarctic Circle several times and into the Ross Sea just off the coast of Antarctica. At one time we were only 250 miles from Little America.

On several occasions I had discussed with Mr. Y. Ogino, the factory manager, my desire to weigh large whales. I informed him that few whales had ever been weighed, and that I was sure we had already processed several that would have outweighed the largest weighed whale on record.

He readily agreed that we would weigh all whales 85 feet and over—to try for a new weighing record. Meanwhile, we conducted numerous other tests.

During the lonely months at sea, I personally investigated many phases of the operation. Japanese officials, inspectors, chemists, and biologists were encouraged to conduct research along lines in which they seemed to have a paucity of knowledge. In a certain sense the factory ship of my fleet, "Hashidate Maru," became a "floating university." Let us hope that our findings on the weights of whales will add something worth-while to the store of knowledge accumulated by others.

From a study of *Discovery Reports* and other scientific books, I had found that the first blue whale had been weighed in 1903 in Newfoundland by Dr. F. A. Lucas, late Director of the American Museum of Natural History. This blue whale, 77 feet (23.72 meters) in length, yielded the following figures:

Flesh	40 tons
Blubber	8 tons
Bones	8 tons
Blood, Viscera, Baleen	7 tons
Total	63 tons

Captain Sorlle at Stromness, South Georgia, recorded the weights of two blue whales, which were dismembered and weighed piecemeal. The smaller, 66 feet (20.30 meters), weighed 107,812 pounds (48,903 kilograms). The larger, 89 feet (27.18 meters), weighed 268,970 pounds (122,004 kilograms), including 17,637 pounds (8000 kilograms) estimated for blood. The biggest dorsal vertebra weighed 529 pounds (240 kilograms).

Dense fog beset us in the iceberg-infested waters in the vicinity of the Balleny Islands. All ships of the fleet, widely dispersed, had drifted to avoid collision with each other or against the gigantic bergs common to that area. Although we had radar, the Japanese skippers were a cautious lot and were reluctant to move unless they had 1000 yards of visibility.

Shortly after noon on January 27, 1948, with slight clearing of the fog, limited searching and hunting oper-

STATISTICS ON THE LARGEST WHALE EVER WEIGHED

MEASUREMENT OF EXTERNAL PROPORTIONS

Date 27 Jan. 48 — Serial No. 319 — Sex Female — BLUE WHALE

	FT.	IN.
1. Total length	89	—
2. Flipper to flipper across the back	9	6
3. Circumference, opposite tips of flippers	43	6
4. Flukes, from tip to tip	19	10
5. Length of lower jawbone	22	10
6. Tip of snout to: Blowhole	17	1
7. Center of eye	18	—
8. Tip of flipper	38	6
9. Ear to eye, center	4	7
10. Notch of flukes to posterior emargination of dorsal fin	20	—
11. Flukes, width at insertion	4	8
12. Notch of flukes to: Anus	23	7
13. Umbilicus	36	9
14. End of Ventral grooves	35	3
15. Anus to reproductive aperture, center	2	5
16. Dorsal fin: Vertical height	1	3
17. Length of base	4	5
18. Flipper: Tip to axilla	9	2
19. Tip to anterior end of lower border	12	10
20. Along curve of lower border	13	5
21. Greatest width	3	9
22. Head length	22	8
23. Skull, width	10	—
24. Skull, length	22	5
25. Tail depth opposite dorsal fin	8	2
26. Whalebone, plate length	3	8
Palate stripped from mouth	19	11

WEIGHT OF DIFFERENT PARTS (Metric Tons)

BLUBBER	
Ventral	4.13
Dorsal	10.11
Jaw	2.58
Head	2.70
Baleen roots	.45
Total	19.97
VENTRAL GROOVES	11.94
BONE	
Vertebrae	7.32
Skull	4.61
Vomer (1)	0.27
Jaw	1.99
Ribs	1.47
Flipper	1.40
Shoulder	0.40
Flukes	0.90
Hyoid (2)	0.08
Waste	0.15
Total	18.59
OTHERS	
Baleen	1.08
Tongue	3.09
"ABA" (3)	1.04
Ovary	0.004
Blood (est)	8.856
Total	14.070

MEAT	
Dorsal	23.06
Ventral	15.99
Chest	4.32
Rib	3.11
Fin	1.17
Shoulder	0.75
Internal	0.73
Head	1.90
Dendo (4)	.39
*Toji (5)	.37
Other	9.44
Total	61.43
INTERNAL ORGANS	
Fat	4.47
Stomach	0.47
Intestines: Small	1.23
Large	0.26
Kidney	0.36
Heart	0.43
Lungs	1.09
Liver	1.00
Carotid artery	0.15
Uterus	0.61
Bladder	0.33
Total	10.40
GRAND TOTAL	136.40

WHALE PRODUCTS

	Raw Material	Shrinkage %	Finished Product
Frozen Products: Red meat	None		
Ovaries	.004	None	.004
Baleen	.25	40	.15
Salted Products: Red meat	51.03	40	30.618
Flukes	.90	20	.720
Dendo	.59	20	.472
Vomer	.27	20	.216
Une (6)	8.67	20	6.936
Intestines: Small	1.23	40	.738
Large	.26	40	.156
Heart	.43	40	.258
Kidney	.36	40	.216
TOTALS	63.994		40.484

OIL PRODUCTION (Metric Tons)

#1 Kverner Boiler	
Ventral grooves	3.27
Tongue	3.09
Toji (5)	0.37
Fat of red meat	9.44
"ABA" (3)	1.04
Gross weight	17.21
Cooking time	4:00
Oil produced	6.3
Per cent	37%
Acid value	0.86
Color: Red	6
Yellow	10

#3 Kverner Boiler	
Internal Organs	
Fat	4.47
Carotid artery	0.15
Stomach	0.47
Lungs	1.09
Bladder	0.33
Uterus	0.61
Gross weight	7.12
Cooking time	4:00
Oil produced	2.6
Per cent	37%
Acid value	0.79
Color: Red	6
Yellow	10

#4 Kverner Boiler	
Vertebrae	
Gross weight	7.32
Cooking time	3:35
Oil produced	1.5
Per cent	20%
Acid value	0.69
Color: Red	6
Yellow	9

#2 Kverner Boiler	
Bones	
Skull	4.61
Jaw	1.99
Ribs	1.47
Flipper	1.40
Shoulder	0.40
Hyoid (2)	0.08
Waste	0.15
Gross weight	10.10
Cooking time	4:00
Oil produced	1.8
Per cent	18%
Acid value	0.74
Color: Red	6
Yellow	9

Hartman Boiler	
Blubber	
Ventral	4.13
Dorsal	10.11
Jaw	2.58
Baleen roots	0.45
Head	2.70
Gross weight	19.97
Cooking time	3:00
No. of fillings	9
Oil produced	10.3
Per cent	52%
Acid value	0.70
Color: Red	6
Yellow	9

WHALE OIL GRAND TOTAL	22.5
CRUDE LIVER OIL	37Kg.
(International unit—110,000)	

TOTAL TIME REQUIRED

Measuring	:30
Flensing, Dismembering, Weighing	3:45
Total Elapsed Time	4:15
Processing Plant Hours	
#1 Kverner Boiler	4:00
#2 " "	4:00
#3 " "	4:00
#4 " "	3:35
Hartman Boiler	3:00
Grand Total Elapsed Time	8:15
Number of men Employed	105
Total Man-hours	546

REMARKS

Color: Lighter the whale oil the higher the grade. First grade pale yellow; lower grades shade to brown.

All meat possible was cut from bones and vertebrae.

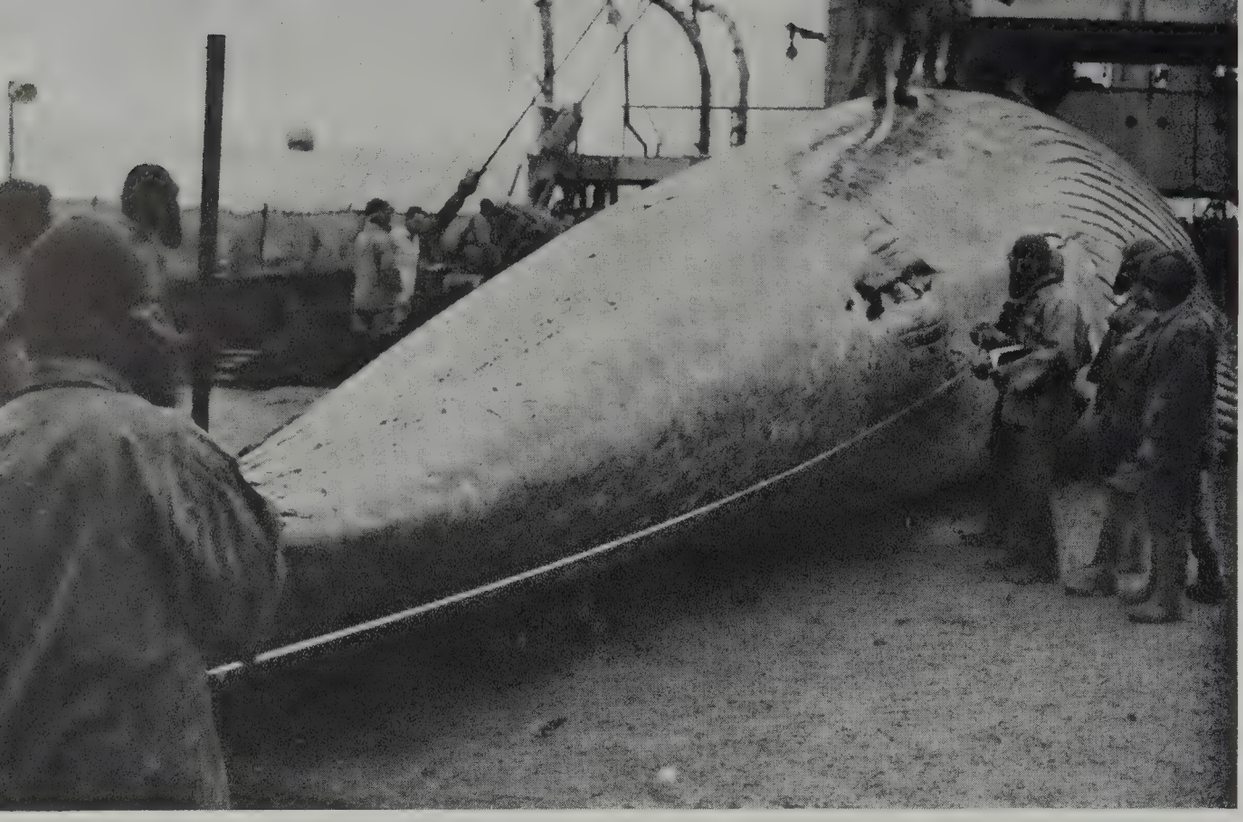
NOTE:

Clinometer (Maximum) during weighing period:

Port	1.5°
Starboard	1.0°

FOOTNOTES

(1) Vomer—Softbone of nose
(2) Hyoid—Throat Bone
(3) "ABA"—Mucous Membrane
(4) Dendo—Fluke Tips
(5) Toji—Jaw Muscle
(6) Une—Fat of Ventral Groove (Belly Blubber)
*Processed for oil



▲ MEASURING THE NOTCH of the flukes on the female blue whale. Never before in the history of whaling had a whale been weighed aboard ship

ations were resumed. At 1410*, "Kyo Maru No. 6" had fastened to a large blue whale. From the bridge of the 10,000-ton factory ship, "Hashidate Maru," we could see the catcher boat silhouetted against the horizon, creeping after her game like a fisherman playing a fighting pike, keeping a tight line, reeling in with huge winches.

Presently from my position on the bridge I observed "Kyo Maru No. 6" drawing its game alongside to be inflated and towed, tailfirst, to the factory ship. A radio message to the factory ship reported that Whale No. 319 had been killed at 1610 and was estimated to be 84 feet in length. I had noted a tendency on the part of gunners to overestimate the small whales and to underestimate the large ones. For this reason I felt sure the whale would be over 85 feet.

I asked the Japanese officials to change plans and prepare for other tests if No. 319 proved to be over 85 feet. This was agreeable to all. As the whale came up the skidway I knew we had a very large whale, but it looked lean to me. Unfortunately, I was right.

The description that follows is summarized from my personal notes taken on the flensing deck as the largest weighed whale in the world was processed.

Ship's Log—27 January 1948

1600 Gentle breeze and misty weather, sea slight.

1635 Received blue whale from "No. 6 Kyo Maru."

At 1705, Blue Whale, female, No. 319 was received on the flensing deck.

Commander Herman K. Sundt, Norwegian Observer, was at the stern with me as the whale, a female, was hoisted aboard. Both of us agreed it was over 85 feet in length, and when it came to rest on the flensing deck we hung expectantly over the inspector's steel tape to verify for ourselves the measured length. It was—glory be—89 feet!

Word passed rapidly among the men, and they knew it would be carefully measured by the biologist and inspector and weighed part by part. The workmen gathered around the gigantic mammal in awe. The huge teats were the size of loaves of bread. The Chief Inspector clambered up the steep ventral grooves and bulging side as if hill climbing. When the outside measurements were finished, the flensers got the signal and the hard work started.

For four hours, I was treated to a kaleidoscopic scene that challenges description. The flensing operation progressed with assembly-line precision, beginning with removal of the huge tail flukes, which measured 20 feet from tip to tip. Numerous workmen swarmed about the 100-meter flensing deck, busily engaged in the tasks of flensing, dismembering, and weighing, while others between decks supervised the processing activities. A whale is usually on its side when hoisted upon the flensing deck. Longitudinal cuts are made through blubber from tail to head, then huge strips of ventral and dorsal blubber are removed in that order. This operation is accomplished by the use of small winches conveniently placed about the deck, while the workmen

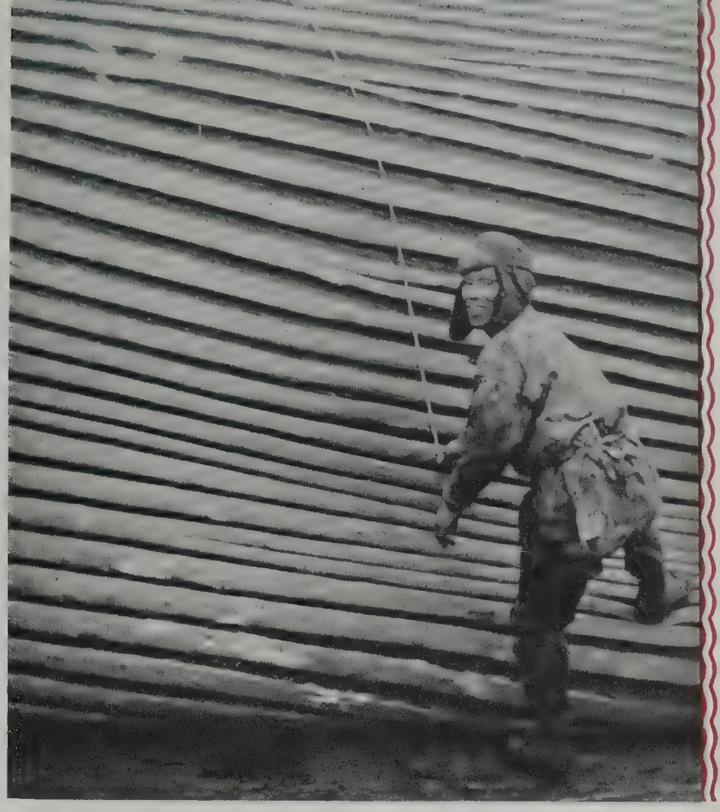
*Time of day is indicated here by the 24-hour clock, in which 1410 signifies 2:10 P.M.

CHEMICAL ANALYSES ON DIFFERENT PARTS OF WHALES

Whale Serial No. 319 — Date of Killing: Jan.
Species: Blue (89 ft.) — Date of Examination: Feb.
Sex: Female — Place of Killing: Lat
Fatness: L — Long.
Freshness: 95%

Parts of Whale	Water	Crude Fat	Solids	R
Blubber	25.4%	61.2%	13.4%	(Prop
Une	25.7	56.8	17.5	dors
Meat of Tail	58.6	25.5	15.9	tral 2.1)
Dorsal Meat	75.0	3.4	21.6	(Belo
Lung	81.3	1.2	17.5	fin)
Heart	76.4	0.7	22.9	
Dendo	69.9	0.3	29.8	
Flipper (center part)	55.9	13.8	30.3	
Oba (center part)	51.5	12.4	36.1	
Oba (blubber)	56.4	6.3	37.3	
Carotid Artery	74.4	0.3	25.3	
Head Bone	22.9	42.2	34.9	
Thoracic Vertebrae	26.0	21.5	52.5	(8th
Lumber Vertebrae	18.0	48.2	33.8	(11th
Vertebrae	8.9	44.0	47.1	(7th
Jawbone	10.8	36.8	52.4	
Rib	20.2	21.6	58.2	(8th
Vomer	68.8	0.4	30.8	die

▲ IT REQUIRED 80 men 3 hours and 45 minutes to flense, dismember, and weigh this 89-foot blue whale



▲ WITH STEEL TAPE these men are measuring the circumference of the blue whale. During the many phases of the gigantic weighing operation, anatomical analyses were made that should contribute to the knowledge of this largest of all mammals

hack at the connective tissues with long-bladed flensing knives.

The rubbery three-ton tongue and ventral grooves came next. Huge 11½-ton loins of rich, red meat peeled from the carcass ahead of spareribs weighing about 1.4 tons. A great mass of internal organs, weighing about 10 tons, spilled from the abdominal cavity. Flank blubber, meat, and ribs pinned on the underside were stripped off in order as the mammoth head was severed from the backbone.

All that remained was the job of separating the vertebrae, joint by joint. Blubber was stripped from the huge snout, and the 23-foot jawbones were severed from the skull.

By the time the whalebone, or baleen, was stripped from the roof of the mouth, the flensing and dismembering operation had reduced the erstwhile monster of the deep to a stack of blubber, bones, and meat.

Dodging chunks of blubber and meat as they were shunted about the deck for different phases of weighing and processing, I seemed to be at the hub of activity amidship near the winch deck. Mr. Ogino, the factory manager, stopped to inform me that the fluke tips had been cut off by the catcher boat to reduce resistance in towing but that they would be brought to the factory ship for measurement. As great blankets of blubber were ripped from the carcass, Keijiro Maeda, Chief Inspector, remarked, "This whale no fatness," and we put down "L" for lean.

"Yes. Very sorry, because I had hoped for a fat one this time," I responded as he moved forward.

At the loading chute and three other points on the deck, the most important activity of the whole operation was progressing. They were weighing chunks of blubber, meat, and bone cut into 40- to 50-pound pieces on small platform scales such as one finds in a feed store. Imagine weighing a herd of cattle, piece by piece, across scales unable to handle more than about 200 pounds at a time. This is how we weighed the largest weighed whale in the world, totaling approximately 300,000 pounds!

Workmen laughed and leaped aboard loins that were skidding forward to the loading chute. Others there started a chanty. Everyone seemed happy. Over and over, they filled the box on the small platform scales, then emptied the contents down the loading chute.

The rattle of winches was continuous as cablemen ran about the deck following their systematic plan of dissection. Small, two-man bone saws with link chain blades were used to cut up the smaller bones.

Hayashi, the biologist, and a chemist moved about the deck selecting various samples for later analysis and study. The ship's doctor and an assistant examined the rotund chin from which whiskers had already been plucked. From past experience I had found that most of them break off at the roots. Whale whiskers are very brittle.

The biologist cut into the huge stomach to examine its contents. Baleen whales feed upon small shrimps, referred to among whalers as "krill," which are found in great swarms along the edge of the ice pack. The species and quantity of shrimps found in the stomach and the degree of digestion were noted by the biologist.

A furtive movement at my flank caught my eye. A silent workman was tearing by hand the covering from the 950-pound heart. Fearfully, he glanced at me as if I might take from him a prize of great value. His dogged determination as he flaked fat from the covering held my attention. The chemist, observing my interest, informed me that the

A TYPICAL ANTARCTIC scene, as seen from the factory ship. All the ships in the fleet were widely dispersed, to avoid collision with each other and with the gigantic icebergs

covering can be processed for a drumhead — Buddhist style. The worker looked at me less fearfully now and by gesture indicated beating of a drum. "Heart covering usually very thin," continued the chemist, "this very thick." I fingered the covering and found it thick as buckskin.

While I was standing on a twelve-inch ledge near the blacksmith shop, a chunk of head meat — nearly half a ton — came sliding across the deck, splattering my clothing and notebook. The cableman looked up at me apologetically as if expecting some critical or derisive remark. I laughed. How could anyone expect to move freely about a flensing deck without getting his clothes dirty! Had the ledge not been there, however, one can hardly say what might have happened.

The factory ship was equipped with six Kverner boilers (twenty-ton capacity) for processing oil from blubber, bones, and meat, and one Hartman boiler (ten-ton capacity) exclusively for processing oil from blubber. There were also settling tanks, centrifugal separators, storage tanks, and a complete plant for processing crude vitamin oil from the one-ton whale livers.

For three years I have worried about my ability to put into words what I saw and felt about this strangest experience of my life. I always want to take everyone by the hand and lead them through each interesting detail. Many have patiently endured this explanation, but I can't say they would care for a repeat performance.

Mealtime had passed by more than an hour when I moved toward the boat deck and my cabin.

"You missed your meal," observed Kenneth Coonan, Australian Observer, as I approached.

"Yes, but I've been waiting for this all season. I can eat any time," I replied, still excited over the spectacle. I continued with my notes as he gazed curiously out upon the mass of blubber, bones, and blood. My hands were so cold from writing barehanded that I had to stop and rub them vigorously to bring back the circulation.

A finback whale was brought upon the deck as I finished eating. I hurried out to delay flensing operations until the deck was completely clean. Number 319 had been brought upon a clean deck, and I wanted it clean before another whale was flensed. This way I could vouch for the weight of the whale. "Saito! Saito!" Where was my interpreter? Returning inside I found Yamagami, my photographer, and sent him for Saito. Impatiently I waited for him to appear. Briefly, I explained why they must wait before flensing another whale, and he hurried off to see Yuge, the chief of the flensing operation. That was settled!

The deck was clearing fast. The last big section of vertebrae was dropped into No. 4 Kverner boiler, and the men who hooked it in followed it with their eyes as it plunged into the heap of bones and meat below. They looked at each other and laughed as if congratulating themselves that it had not stuck in the opening, from which they sometimes had to probe huge bones with a long iron bar. Two boilermen appeared and began to close the door and to put on the cover before steam at 60 pounds per square inch could be applied.

No. 3 and 4 Kverners were soon closed, and the rib sections moved across the deck to No. 2. Most of the 61½ tons of meat had disappeared down the loading chute, and men were cleaning up around the bone

saws to collect flakes and scobs of bone torn out by the heavy-bladed saws.

The chief of the flensing section, Yuge, laughed good-naturedly and spoke to Saito. I looked inquiringly his way and Saito explained, "He says that in seven seasons in the arctic and antarctic this is first time he has ever seen a Japanese factory ship processing a whale this way."

"You can tell him that this procedure has probably never been followed before on any whaling factory ship in the world," I replied.

Covers had been placed on No. 1 Kverner boiler containing ventral grooves, tongue, *toji* (jaw muscle), fat of red meat, and *aba* (mucous membrane). The last ribs were dropped into No. 2. The boilermen let themselves down into the two-deck opening to close the doors of the great boilers, containing over ten tons of raw material. This boiler will hold nearly twenty tons of meat and blubber, but we put only bone in No. 2 in order to determine the percentage of oil produced by actual processing.

It had required the efforts of 80 men about 3 hours and 45 minutes to flense, dismember, and weigh, part by part, this largest whale ever weighed. Twenty-five more were working below in the processing section.

Through binoculars, I had watched "No. 6 Kyo Maru," only a few miles distant from the ship, when she secured this whale. It must have been only a few minutes after the whale was harpooned, because I could see the harpoon line hanging down from the bow and finally the slow roll of the animal as it was brought along from the bow and secured to the catcher boat for towing tailfirst to the factory ship.

Later, Sutekichi Kikuchi, the gunner, told me that firing the final harpoon into the huge creature had been difficult because each time the catcher boat drew the animal within range, it would dive. For two hours the struggle continued until finally the *coup de grâce* could be administered, and the spirit of the huge leviathan, "Kujira Kuyo," was released to rove restlessly in space until, reconciled for its untimely demise by the annual Buddhist ceremony "Kujiro No Kuyo," it could journey into whale heaven and become Buddha.

It was possible to weigh this whale on regular platform scales because the ship was stabilized by 600 tons of sand ballast. The roll of the ship averaged an arc of less than two degrees on the clinometer during the flensing, dismembering, and weighing, because there was only a slight sea at the time. A test observation revealed maximum roll to be one degree starboard and one and one half degrees port.

When weights of blubber, bones, meat, internal organs, and other parts were added up, we had an actual weight of parts of 281,087 pounds, or 127.5 metric tons.* Estimating the blood and stomach contents at about 19,500 pounds (8.856 metric tons), Blue Whale No. 319 weighed approximately 136.4 metric tons, or 300,707 pounds!

Whale oil produced was 22.5 metric tons (133 barrels), valued in 1948 at approximately $440 per ton, or $9,900. Red meat stripped from the body weighed 61.4 metric tons. Allowing for shrinkage, frozen and salted products totaled 40.484 metric tons. The meat products were valued at approximately $18,000. The total value of all products exceeded $27,900 from this one whale carcass. Without shrinkage from salting, it would have been more. You will notice that the meat, which is often considered of no importance, was actually worth about twice as much as the oil.

Upon our arrival at Osaka, the Japanese lost no time in announcing in their *Shimbun* (newspapers) their accomplishment in weighing the largest weighed whale in the world. Apparently this "scooped" all Allied newspapers. I had received confirmation on previous whale weights from the International Bureau of Whaling Statistics, Norway, a few days prior to landing and so informed the Japanese. I thought it was a "scoop" accomplishment myself, but others were slow to share my enthusiasm. Larger and heavier whales were caught by the expedition, but they were not officially weighed and recorded. The First Fleet had weighed 27 whales (16 blue and 11 finback) and recorded them—a record-shattering event on any whaler's logbook!

*A metric ton is 1000 kilograms, or 2204.6 pounds.

HUNKS of blubber, meat, and bones, cut into 40- to 50-d pieces, are weighed. The four small scales that were used unable to handle more than 200 pounds at a time

▼ MEASURING THE SURFACE area of the whale was a laborious task accomplished by Biologist T. Hayashi (*left*). K. Maedo assists, as the author looks on

U. S. Army ph

"It is a ravening beast that biteth deep and poysoneth deadly," wrote one 17th century naturalist. He was not describing some prehistoric monster. He was referring to a very tiny, sharp-nosed creature called a shrew, which at that time was feared as much as a viper.

But those beliefs were soon put in the class of quaint folklore; and when the science of bacteriology was born, it was said that shrews were no more poisonous than a common house mouse—the danger was simply from infection. But this reasoning broke down in 1889.

In that year a Mr. C. J. Maynard was accidentally bitten by a shrew. The skin on his fingers was punctured scarcely enough to draw blood, yet within 30 seconds a burning sensation shot up his arm and the area began to swell rapidly. Shooting pains lasted for a week, and the swelling did not go down for nearly two weeks. Here was something quicker than bacteria!

After hearing what happened to Maynard, Dr. Oliver Pearson got busy on the case. In the salivary gland of the short-tailed shrew he found a unique type of granule. When he injected saliva from this gland into mice he found it to be quite poisonous. It quickly brought on paralysis in the hind legs, labored breathing, and bulging eyes. The mice died in as little as three minutes, in a series of violent convulsions. The effects of this venom show that it is quite similar to the nerve poison of the deadly cobra. The glands of a single shrew have enough doses of it to kill 200 mice!

The shrew knows just how to use it to best advantage: Observers have noted how the short-tailed shrew bites mice through the skull —the very place where a nerve poison could act most rapidly. If the poison does not kill the mouse, it will render it so sluggish that the shrew has the upper hand in any battle.

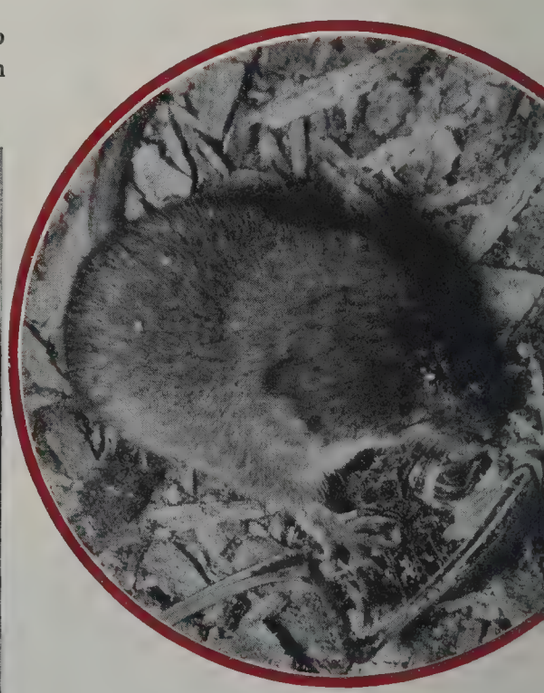
Tiger of the Grass Roots

The short-tailed shrew has an appetite for twice its weight daily and carries poison enough to kill 200 mice

By Tom McHugh

Photographs by the author

▼ The short-tailed shrew (*Blarina brevicauda*) in a defensive pose. So rapid were the animal's movements that the picture had to be taken with speedlight, at about 1/10,000 of a second



▲ The victim: a field mouse, d
structive to farm crops, shor
tailed shrews help to reduce hig
numbers of these animals

This midget of the grass roots then turns out to be quite a package of dynamite. It is a beast with a bite like that of a weak cobra, an appetite of as much as twice its own weight in meat each day, and the power to whip an animal three times its size.

At the same time, there is no reason to fear the shrew. You will ordinarily have difficulty in getting close to one, and many scientists have handled dozens of them without being injured in any way. Actually, they are of great benefit, because they can eat their weight in insects each day, and they keep mice in check.

The startling thing about these animals is their small size. The body of the common type is only about two inches long. And I say "common" with reason—they are all around us. You or I never see them because they scurry through small tunnels under logs or leaves. But they are there, nevertheless. In the woods and fields, right up to the very edges of the city, and even in some vacant lots, they abound wherever there is cover and food.

Food for shrews is usually snails, insects and earthworms, but it may include almost anything that moves. For their size, they are the most bloodthirsty and ferocious creatures alive; they love nothing better than using their sharp teeth on a living victim. One scientist was foolish enough to put three shrews together in the same cage. A few hours later he found only one shrew left—one shrew with a very fat stomach.

A shrew loves to dine on a mouse, even though the victim is twice his size. When he tackles a mouse, a gory drama unfolds, a battle as furious as a grizzly's attack on an elk reduced to a Tom Thumb scale.

As soon as the shrew gets the scent, he gives quick chase and seizes the mouse's tail in his teeth. The mouse tries to flee and drags the shrew along behind in cave-man style. Then the shrew makes another lunge and grabs the mouse around the belly, rolling over and over with it in a mad melee of biting. By this time the poison is slowly taking effect, and the mouse is becoming more sluggish by the minute. The exhausted prey frees itself only momentarily, for next the shrew has it by the ear and starts to munch on that tender item. Again the mouse tears loose, and again it is seized by its foe, this time in the final death struggle. The shrew's battle is won when he crunches through the skull and begins eating his dessert first—mouse brains. The whole tragedy may take as little as ten minutes.

This particular battle was watched in a cage when the two opponents were placed together, but the same thing happens in the wild. One shrew was caught in the act of chasing a field mouse through its tunnel. It unwittingly chased its prey right into a mousetrap set by a mammalogist. The trap caught the shrew by the neck and the mouse by the hips—a perfect "Exhibit A" to prove the chase.

These depredations of shrews on mice occur regularly and make the shrew a very beneficial animal. Professor W. Robert Eadie investigated the winter nests of short-tailed shrews and found that many were feeding on field mice. When the shrews were at the height of their mouse-eating activity, the field mouse population in the area dropped from 80 per acre to 12 per acre. Professor Eadie figures that shrews might have accounted for at least 14 of these mice in each acre, and he adds that circumstantial evidence points to a higher figure.

Whether it be mice or snakes, the fearlessness of a shrew is incredible. One man placed a two-foot water snake and a short-tailed shrew in the same box. The snake was quite lively when placed in the cage in the afternoon and bit at everything within reach. The next morning, streaks on the glass sides of his prison documented his efforts to escape. He was then lying on the floor exhausted, while the shrew was busy tearing out his jaw muscles.

The poison obviously aids the shrew in its never-ending search for food; for above all, this pugnacious assassin is a slave to its stomach. Very seldom does it rest. Perhaps that is why death from old age comes at but 14 months.

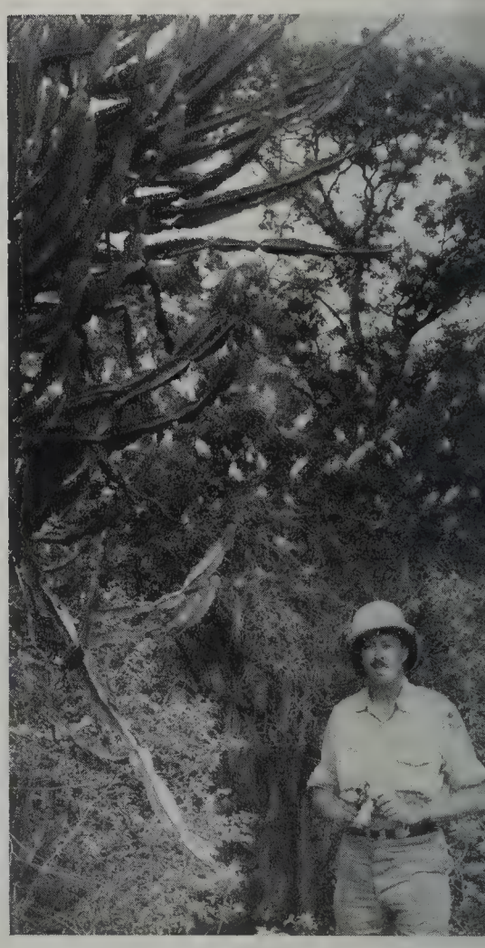
▲ SHREWS are the smallest mammals. This common shrew (*Sorex cinereus*) weighed about as much as a five-cent piece

Egrets—
The Hard Way

By Russell Barnett Aitken

Photographs by the author

▲ Some of the older egrets were huddled like statues on the tips of the cactus-like euphorbias



▲ The author in egret territory. T birds decorated the trees like Christ tree ornaments, and their chattering incessant

What started out as a simple bird-watching trip in Natal proved to be a perilous pastime when rains trapped the author in Zulu territory

READING a newspaper in a New York taxicab is one thing, and trying it in a bouncing rickshaw in southeastern Africa is something else again.

A carved wooden bird on the big Zulu's headdress bobbed blithely as he hauled me over the cobblestones of the quay toward the Marine Parade, his skin glistening like polished leather. In a tattoo synchronized with the rollicking rhythm of a lusty barcarole, the steaming pavement resounded to the padding of his naked feet. When I recognized a few of the Kaffir words, I realized that my human horse was chanting an *isibonga* extolling the prowess of his ancestors in bygone days when bloodthirsty Zulu impis rattled the assegai against oval oxhide shields to terrorize this land.

From time to time in sheer exuberance my meandering minstrel would vault high into the air between the traces in a maneuver that forced me to grab hastily for the sides as tail gate scraped asphalt. His massive shoulder muscles rippled smoothly under his exertions, and he carried himself as if supremely conscious of his physical fitness. The white man might have succeeded in breaking him to harness, but nothing could destroy the natural arrogance of a race whose warriors were famed as the fiercest in all Africa.

As we reached the Parade he leveled off to a steady jog trot without acrobatics, and I was finally able to peruse a copy of the *Natal Sunday Post* that I had purchased on the Durban pier. There wasn't much news until I turned to page 24—and that's where my troubles began.

Photos of egrets occupied the entire page, interspersed with shots of black-headed herons. Being incurably interested in natural history, I went on point like a bird dog. Reading carefully, I learned that the rookery was on the Umgeni River "about twenty-five miles from Durban."

This was the buff-backed egret, the ubiquitous bird that consorts

▲ THE RICKSHAW BOY'S headdress was composed of beadwork, cow's horns, a carved wooden bird, and discarded light bulbs embellished with turkey feathers. Note the banded porcupine quills at the very top

with cattle, buffaloes, and elephants in order to snatch grasshoppers stirred up by the grazing animals, and hitchhikes on their backs to save exertion. The species is found throughout Africa, and in Egypt unscrupulous dragomen point it out to gullible tourists as "the sacred white ibis."

On previous expeditions I had often seen these egrets in the marshes or flying homeward in the evening in large flocks, their measured wingbeats being poetry in motion. To visit them in a rookery such as the paper described would be a rare opportunity.

The local phone book soon solved the problem of transportation, and

▲ THE ZULU GIRL who had the bearing of a princess and was as nervous as a trapped leopard

with an address scribbled on a scrap, I rickshawed to the office of a chartered cab company. A tiny woman with silver hair at the desk said that she wasn't exactly sure where the bird sanctuary was located but she would call the gazette and find out. Leaving a deposit on my hired vehicle, I left instructions for a driver to pick me up dockside at seven the next morning.

When I awakened, the boat was rolling slightly, and since it was too early for scheduled breakfast, I settled for a bit of stale toast and a cup of the strong black coffee always on tap in the big urn in the galley. Since the weather had been sultry, I wore lightweight khakis and a sun helmet, and when I walked down the gangplank and over the scattered freight piles I found the taxi waiting.

Its chauffeur proved to be the little gray-haired lady of the day before! The agency was shorthanded, she explained, and the war had been responsible for women learning many trades.

We rolled out past the Berea sandstone and into the lush green hills, past blue gums and wattle and banana plantations, and it wasn't until an hour later that I realized my driver was quite vague about our destination. We were a good 60 miles back in the hills and slightly lost when a friendly engineer told us that the birds were some 40 miles away in a different direction. He also recommended abandoning our quest, since it would entail motoring on a one-way mountain road under construction. He added a warning that the engineers would be expecting no traffic and might well crash head-on into us on a curve. His advice merely served as a stimulant to the little woman, who was evidently determined to find the birds if only to prove that she could finish what she started out to do.

Ignoring a large sign prohibiting travel on the Zulu Reservation, she plunged onto the forbidden land and soon was lost once more when the dirt road forked, unmarked. From the slope of the mountain above us came the sound of native voices blended in remarkable harmony, so we climbed toward a thatched native schoolhouse where it originated. A native in horn-rim-

▼ THE QUEST for the egrets led past pe
ful Zulu kraals nestled against the slo

◀ WITH 50 to 60 nests in every tree, the egrets were living like tenement dwellers. Yet beyond their half acre of slums, the euphorbias were bare of birds

▼ A DISTANT RELATIVE, the Crowned Crane, eyes the untidy rookery of the egrets, seemingly with disgust

med glasses approached and proved to be the headmaster, a courteous chap who spoke flawless English and helped orient us. As we started back to the car, the childish treble of 50 small Zulu children rose in crescendo in magnificent music.

We found the engineer's road finally, but it cost us another hour of wandering past neat Zulu kraals, past bronzed women hoeing mealies, and fat cattle browsing. I was responsible for a short halt when I asked my pint-sized driver to stop while I stalked a Zulu maiden who was shy as any antelope on the veldt. Crouching in the high grass in ambush, I snapped her picture as she passed a great clump of devil's-daggers. At the click she bolted into the bush like a duikerbok. I called after her, *"Vela sikubone wena"* (Come forth that we may see you), but it took the woman's wiles of my driver plus the clinking of a few shillings to persuade her to emerge. With high-swept coiffure she had the bearing of a princess, accented by a headband of beadwork. Between her eyes dangled a triangle of big red and white beads, and all during the session before the camera she was nervous as a trapped leopard.

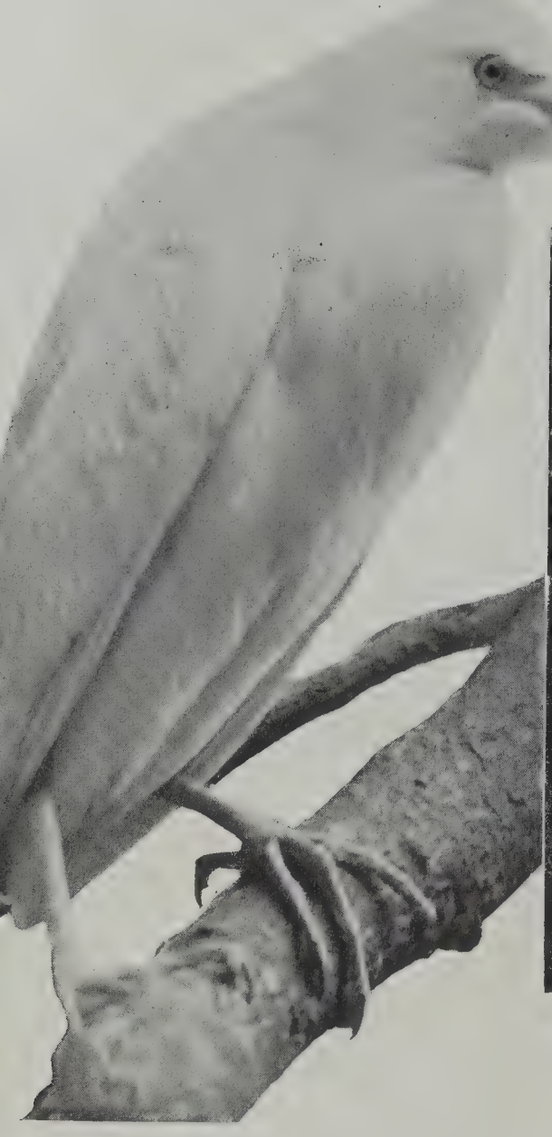
We were soon far into Zulu country, and above us purple clouds were gathering in ominous fashion. I didn't fancy their looks, but these, like the "posted" sign, were ignored by my intrepid female guide.

Just about the time we were ready to turn back, discouraged, we stumbled upon the birds, and it was a fantastic sight. The patch of euphorbia they had picked was scarcely half an acre in extent, and they dotted the cactus-like trees as if they were Christmas tree ornaments. The surrounding euphorbias were bare of birds, yet the rookery was overflowing until branches were breaking under the weight of the close-packed nests. Like tenement dwellers they had built 50 to 60 nests in every tree until it hardly seemed there could be breathing space for all the occupants. The nests themselves were haphazard affairs made of short lengths of reed or twigs placed crosswise. In one where the mother bird was absent, I saw a clutch of four pale blue eggs.

As I got out my photographic paraphernalia, a few big raindrops splashed across the windshield of the car, and I knew I wouldn't have much time. The black clouds that bunched over us promised dire things and were no help whatever for picture-taking.

As I approached the rookery the din was deafening, and it increased in volume each time I neared a nest-laden tree. The birds themselves showed little fear and none of the wariness characteristic of them when met in the bush. Consequently, I was able to see many at extremely close range. This was the buff-backed egret (*Bubulcus ibis*), which is stockier than most other herons and has a yellow bill and orange-yellow legs. The eyes and lores are pink, and during the breeding season the plumage of the head, crown, back, and breast is a rufous-buff, with the rest of the bird snowy-white except for a creamy edge on the wing coverts. Its untidy housekeeping and raucous voice coupled with the rain made serious photography difficult in the extreme.

A bedlam of boisterous birds surrounded me. Fathers were screeching to their mates, mothers clucking to their young, youngsters battling each other, and fledglings, ousted from the nests, were squalling piteously on the ground. Even as I watched one particular nest, a fledgling wobbled to the edge in a greedy effort to intercept his food-laden mother as she alighted. The rush of his brothers shoved him right off the edge to plummet 30 feet downward, where he bounced off the moss like a rubber ball. It didn't seem to injure him, and since it was impossible to climb the euphorbia, I simply placed him in a lower nest. The two



◀ THE BUFF-BACKED EGRET is stockier than most other herons. It has a yellow bill and orange-yellow legs. The eye is pink

▲ THE BIG BLACK-HEADED HERONS were top dog in the rookery. They kept the egrets segregated in the lower floors of the apartment

occupants squawked and stabbed at the intruder, but even so, I decided he was safer there, unwelcome as he was, than at the mercy of hungry mongoose or genet on the ground. Above him his brothers were oblivious to his problems as they fought for a chance to delve deep into their mother's beak after food.

In another nest a brooding matron was minding her own business when a neighbor walked on her head. As soon as the foot was removed, she coiled her head like a cobra and stabbed him in the posterior with a needle-sharp beak. Her unmannerly visitor departed in haste. A group of egrets in the higher branches were playing a sort of "King of the Mountain" game, flying at a comrade on a perch to confiscate his place, only to be challenged and dispossessed themselves a moment later. Older birds were huddled like statues on the tips of the euphorbia arms, glum and solemn. A single bird to my left was ignoring all the rest; framed between two spiny arms in handsome fashion, he was disguised as a Japanese print.

The chattering white birds were held in a sort of semisegregation by the big herons. These bold black-crowned buccaneers were top dog in the roost, their roomy nests occupying the tip-top branches of the tallest euphorbias. Occasionally one or two egrets would alight furtively at the edge of the heron nests as if paying their respects, but I noticed they kept out of range of the snake-like head of the bigger bird.

The rain was pelting down now, and my driver was making frantic motions to me to finish my work. The red dirt road was slippery as I hauled my equipment back to the car, and it was only when we headed back up the mountain grade that we discovered the rain had been coming down heavily behind us all the time we had been at the Umgeni. It had reduced the road to muck. To make it worse the narrow highway was flanked by sheer drop-offs running into thousands of feet. Lacking chains, we slithered out of control toward them far too often. Several times I found myself looking past the door handle at jagged rocks far below and wishing fervently for a parachute, particularly when one vicious skid took our rear wheel half over the rim of the precipice. Around the next bend the road slanted the opposite way, and this time the skid catapulted us into the bank and into adhesive gumbo up to our hubs. No amount of coaxing would extract the vehicle from the trap, and the spinning wheels only dug deeper.

The rain by now was a torrential downpour such as only monsoons can produce, and when I stepped out to push I was soaked to the skin within ten seconds.

We were bogged down in the mountains on forbidden Zulu territory, and it was highly unlikely that anybody would come looking for us in that remote spot. My wristwatch said five o'clock, and neither of us had eaten since early morning, my breakfast having been barely enough to keep a canary alive. We had brought no lunch, since we had hoped to make the trip in a few hours, and we had more water than we cared for. Adding insult to in-

jury, the car had been hired by the hour, and already the cost had mounted alarmingly.

Remembering a Zulu kraal a mile back down the road, I decided to hike there to enlist some natives as pushers—an excellent scheme which failed, owing to the absence of all males. The only inhabitants, two fat Zulu matrons, accompanied me back to the car. The downpour had reduced my sun helmet to a limp toadstool affair with undulating brim, and my last few cigarettes were floating around in my pants pockets.

The Zulu women offered to help push, and we tried it. It must have made a ludicrous scene, now that I survey it in retrospect, with the wispy gray-haired lady at the wheel and me up to my knees in muck, flanked by two tribeswomen who were stark naked except for a leathern moocha, a sort of small apron, and the usual strings of beads. It was a picturesque if unsuccessful attempt at liberation.

Several other natives had arrived now to watch our little act, and one of them was an intelligent-looking youth. "Hey, John!" I yelled at him through the downpour—all Zulu men being called John by the settlers, just as all Zulu women answer to "Mary." He shuffled over. "*Inkabi?*" (Oxen?) I queried hopefully, and when he nodded his head shyly in affirmation and said that he had some at his kraal, I sent him off posthaste. When he returned an hour later, my hopes were somewhat dashed because the "oxen" proved to be heifers, scrawny ones at that.

The lad seemed so proud of his pathetic beasts that I decided to humor him. I pointed to the bogged-down car.

"*Bopelanini izinkabi zetu!*" (Hitch our oxen at once!) I ordered, and he hastened to comply, coupling them to the bumper with barbed wire and a length of rusty logging chain. Conscious of his admiring local audience, he made a big production out of it.

With the heifers ahead, grandma at the wheel, and my assorted naked comrades flanking me behind, we were ready to try again. The motor roared, the Zulus grunted, the boy yelled at his teams, but all that resulted was a wave of muck thrown over us by the spinning wheels. Then we tried it without the engine, and slowly, surely, the patient beasts, augmented by our man and womanpower, pulled the stricken vehicle from the bed of mud that had entrapped it.

It was a happy moment, except that I remembered other grades and other traps that lay ahead. We weren't out of the woods yet, and I was frankly frightened at the thought of the precipices yet in our path. With a modest amount of haggling, I quietly coerced the boy into convoying us with his yoked teams for the few remaining miles of treacherous road. Using the engine only to assist the animals on the steeper grades, we finally emerged onto the wider surfaced highway.

With a hasty good-by to our young rescuer, we scooted over the good road, completely forgetful of the fact that to get off the Reservation we would have to climb one more unsurfaced hill. We tried to make it ten times, our wheels spinning without traction, only to slide inexorably back down. We surrendered, finally, to huddle hopelessly in the car, wet and hungry and facing the prospect of combatting the chill mountain air. The rain was still descending in torrents.

There was no glimmer of light to be seen anywhere through the wall of water, and there was nothing left to do but make the best of a bad deal. Grandma, shivering in her thin cotton dress, curled up on the front seat, while I jackknifed my long legs onto the rear cushions after removing my muck-covered boots.

All night long, when I wasn't wondering whether my ship had sailed without me, I kept thinking about T-bone steaks I had known, thick juicy ones, until I was ready to eat the upholstery. I was afraid to doze for fear of waking with pneumonia, and the clammy clothes helped keep me awake.

With the advent of daylight, Zulus began trekking past toward Botha Hill, and we sent out messages by them. It was almost noon before we got an answer from civilization in the form of a tow truck, and to complicate matters it almost slid down the hill on top of us. It took the brawn of a dozen husky natives to get us and the truck back up the slippery slope to the main highway. When we stopped at an inn for sandwiches and coffee, we wolfed the food as if we'd been marooned a month.

My boat fortunately was still in the harbor, the skipper having insisted that the police hunt for my corpse all over town. Eventually I left the delights of Durban, but I knew I wouldn't forget Natal in a hurry. It was there that I'd met the egret—to my *re*gret—and I vowed in the future to leave bird-watching to seasoned ornithologists. I'd stick to rhinos; they're easier on the nerves.

▼ THE BEGINNING of a bad night. The Zulu boy and his "oxen" convoyed the car to what seemed to be a safe place. But one more stretch of mud halted the expedition until the following noon

Adventures in the swift waters of th Surumu and in the financial philosophy o a band of copper-colored rivermen

By GEOFFREY M. TATE
Staff Member, Archbold Expeditions, American Museum of Natural History

Lee Garnet Day Expedition Photographs

A Fair Day's Pay

BY sheer contrast, I was reminded recently of my first experience in paying natives by means of trade goods. I had gone over to see my friend, Henry, the purser of the good ship "Pioneer Star," which brought members of the 1948 Archbold Cape York Expedition back from Australia. He was paying off the crew when I called, and I watched the money change hands as the men filed in front of his window. Everything moved and clicked like well-oiled machinery, but my thoughts skipped back through the years to the sound of native drums in a forest clearing and to a very different payoff with a fantastically incongruous currency.

Don Carter, my brother George, and I were working our way north from the Amazon River toward Roraima, that phantom mountain of many legends. We were not the first to climb the sheer cliffs protecting the flat summit of Roraima, where the ghosts of the dead Macusi and Jarecuna warriors find their happy hunting grounds, but we were the first to explore fully its cold, mist-swathed top. My little story deals with the part of our pilgrimage between a settlement called Frechal and the native village of Maloka Limaõ, in the territory of the Macusi. Frechal lies on a tributary of the Amazon called the Surumu. The rapids of this river ran with such fury that we simply were not strong enough to get through with our two canoes—a heavy one that we had brought clear up from Manaos and a light one we had purchased from the Frechal rancheiro. So George had gone ahead to Limaõ in order to send back additional Indians to help us.

It was late afternoon when the Indians reached our camp among the trees along the river. They were copper-colored, muscular, squat little men—robbers, murderers, cannibals, and worse, said the rancheiro as he hustled his family into the stockaded shelter of his home. Indeed, we knew that the reputation of the Macusi was not founded on gentleness. They looked everything that the rancheiro said they were. A few wore flapping rags of pyjama-like suits, but most were naked save for a breechcloth of dirty red cotton. They carried knives in their girdles, and each man was armed either with bow and arrows or with

the *sabutana,* the blowgun. Some wore on strings around their necks the bulldog jaws of *pirai* – the deadly little fish of the rivers, which hunt in shoals and can strip the flesh off anything that swims. A few had their lower lips pierced and wore nails or sharpened bits of metal in the opening. A stripe of red paint across the bridge of the nose, from cheekbone to cheekbone, added a further touch of ferocity to countenances needing no such embellishment. Tough guys they were said to be, and tough guys they looked.

Their leader handed us a note from George. Our qualms were in no way allayed when we read it. After a short description of the river, it stated that there was much cashiri and paiwari being consumed in Limaõ and that the *tushagwa,* or chief, was drunk on it most of the time. In George's estimation, the sooner we were together again and could offer a solid front, the better. We started the next morning.

We knew from George's letter that we had four sets of rapids to traverse: the Casa Verde, the Maruai, the Providencia, and the Pedra Grande – each more difficult than the one before. However, Don and I hoped to make the trip in five days. It would have been advantageous to portage our food and equipment at the long rapids (both the Providencia and the Pedra Grande ran for over a mile), but this was partially prevented by the size and weight of the canoe we had brought from Manaos. George had purchased her, and his poetic fancy had inspired him to name her "The Pig and Wallow," slightly reminiscent, perhaps, of some country pub in England. She looked every bit her name—this queen of our little fleet. She was about 25 feet long, incredibly broad, and made of planking nearly 3 inches thick. A thatched roof had been constructed over her stern for six feet, making living quarters. Eight men were needed to paddle her in still water, more in rapids, and a whole platoon would barely have been able to lift her. So it came down to a manhandling job for the boat and a carrying operation for supplies and gear.

We started at daybreak. The Pig's crew of ten Macusi paddlers, four to a side and two at the stern, made her travel through the water at a very fair speed. Taking alternate strong and short strokes, they would tap the shafts of the heavy homemade paddles against the gunwhales of the canoe, producing a sort of rhythm that they could keep up for hours. The smaller boat had no difficulty in keeping up with The Pig, and there were no mishaps on that first day, though our thoughts were constantly with George and the alcoholic *tushagwa.*

We reached the Casa Verde rapid early the next morning. Here the river was split by a large sandstone island, and the water, compressed on each side of it, ran like a millrace. We unloaded all our movables and carried them the quarter mile up to still water. Then we returned to face the problem of The Pig and the small canoe. We had to depend upon paddle, pole, towrope, and sheer muscular force. The Macusi were like so many fish in the water,

▼ CLOSE TEAMWORK and great physical exertion were necessary to work the unwieldy "Pig" up the Surumu through its four rapids. The jungle men who did the work did not know the meaning of monetary reward

Photo by T. Donald Carter

TO LIGHTEN the boats, the baggage was usually portaged up one side of the river or the other. A slip might mean a plunge into deep water and a leg torn on a jagged rock

Photos by T. Donald Carter

encouraging each other with shrill yells and shouts of *"Cai en agua"* (roughly, "get in the water and work, you so-and-so"). When one of their number would slip on the shelving, slimy rocks and skin his leg from knee to ankle, they would laugh with sadistic glee. We were all pretty well used up when we reached the head of Casa Verde rapid, but before slinging our hammocks and making camp we loaded the canoes again, ready for an early start the next morning.

For a few miles, the traveling was uneventful, though of course the farther up we went, the more powerful and difficult the obstacles became. We were determined to lose as little time as possible, not knowing how things might be with George. The second rapid, the Maruai, was a tough one and gave us warning of what we might expect at Providencia and Pedra Grande. Cliffs formed the banks of the river at Maruai, and the job of getting all our stuff up the steep bluffs to the trail was an exhausting one, not to mention carrying it for a full half mile. Then came the matter of getting The Pig and her consort up the rushing stream.

In spite of their great aquatic ability, the Macusi were constantly swept off their feet by the force of the current. When that happened, they had to cling to the sides of the boat to save themselves from being swept away. Meanwhile, those of us who remained upright, braced ourselves against the double burden of boat and men and strained every muscle and tendon to prevent the whole works from being washed down to the foot of the rapids. We finally conquered the Maruai, but one rapid like that was enough for one day. When we made camp, the Indians were as tired as Donald and I. Only Sunny, our little mascot dog, who seemed to enjoy being battered around by the torrent, had much spirit left.

The muscular, compact bodies of the Macusi seemed to glow in the light of the fire as they sat in a circle around a community stewpot, dipping their hands in and tearing and gnawing the tough beef. Tough, sullen men they certainly were, squatting on their heels in simian posture, but where could you find better rivermen?

The stars were still shining brightly when we started out the next morning, and the waning moon bathed the river and its banks in a pallid blue radiance. In the cool morning air, we felt optimistic, but when we entered the Providencia, we realized that only good luck would enable us to complete the journey in the two days that remained in our schedule.

This rapid was about a mile long, and we started our battle against it in the early afternoon. By nightfall we had worked our way up about three-quarters of its length, and we knew that we could not fight the river in the dark. So we made our boats fast fore and aft to trees on the bank, in an eddy away from the full pressure of the stream. Then we

Photo by G. H. H. Tate

➤ Most of the Macusi were naked except for a red breechcloth. They carried their hunting weapons with them and were a tough-looking group of men

cleared a small space in the underbrush and made camp there.

Heavy black clouds to the north heralded a deluge, which we knew would flood the river. A couple of days before, a cloudburst in the same direction had raised the stream four feet in one night. We felt that, while we could escape the Providencia as soon as we had light enough, the Pedra Grande, which was the worst of the four, would give us such a battle that the others would seem like child's play. George, marooned up there at Limaõ, had reported that it had taken his party nine hours to overcome it, and they had been lightly loaded. Don and I felt more than a little awed.

Rested and fresh from a night's sleep, we passed the remainder of the Providencia and reached the foot of the Pedra Grande in fairly good time. Here the river, a couple of hundred yards in width, foamed and thundered between two massive granite tors, each about a hundred feet high. We had met our Scylla and our Charybdis, and we hoped that the luck of Ulysses would be with us.

We followed the usual procedure of landing and unloading, and portaged our stores to less exciting and excited waters above the rapid. There we tethered Sunny, too, not daring to let him pit his stout heart but light weight against the whirlpools and cascades of the Surumu. Then we walked back and started the worst tussle of the lot.

The depth of the water in the Pedra Grande varied. In some places there was a bare twelve inches where the stream flowed over a shelf of rock, but the next step might take you into a pool five or six feet deep. Fortunately, there were trees scattered along the riverbank, to which ropes could be fastened. Sometimes we would expend the most stupendous effort for fifteen minutes to make secure a gain of only a few feet. Rocks jutting from the foaming water could be used to advantage as snubbing posts, but they also became deadly menaces against which the boat might crash when she slipped from our hands. There was one great thing in our favor — there was no danger from *pirai* or alligators in water as bad as that.

"Cai en agua," yelled the Indians to each other, and *"Hi capybara"* (referring to an animal famous for its swimming ability), when one of them slipped and was washed along one of the jagged stone shelves or disappeared beneath the surface to emerge 10 or 20 feet downstream.

Disaster loomed ominously close when at one point all the men supporting one side of The Pig were swept off their feet. The boat was snatched from the grip of the men on the other side and from those who were towing, and was smashed with sickening force against a sharp-edged rock. Fortunately, none of the men were hurt (no one was caught between rock and boat), and she stuck there long enough for all hands to get back on the job and bring her under control. But the poor old Pig's three-inch timbers were cracked, and a part of her heavy keel was sheered clean off. It

became a personal fight; everybody cursed the current. Muscles bulged; tendons and sinews cracked. The stout poles frayed and split at the ends. A hot sun beat down, scorching the parts of our bodies that were not under water. In the distance, Sunny's excited barking lent further encouragement to us. Gradually the powerful stream lessened; the undertow swept less violently at one's feet and legs; the sharp rocks became less frequent. And then the job was done, and the mile of wild white water was passed — in six hours.

From the head of the Pedra Grande to Maloka Limaõ was only a half hour of easy paddling. We found George hale and hearty, and over his shoulder Guaracaibo and our private Peruvian Indians were grinning a welcome. Behind them was the whole population of the village, augmented by a hundred or so other Indians who had come long distances for jobs as porters. One sturdy savage, whose garb consisted almost solely of a woolen skullcap, poked a knotty thumb into his chest and said *"Inglis, Inglis,"* meaning that he had come all the way down from British Guiana. But before we could sign on porters for the overland job, we had to pay off the rivermen for getting us to Limaõ.

George had told the Chief that they would be paid on the day after our arrival. That evening, after I had issued some dried fruit to our cook and it had been stewed for a celebration supper to commemorate our reunion, the boxes containing the trade goods were opened. We constructed shelves from our collecting and specimen cases on which to spread the galaxy of wondrous things from which the Indians would make their selections. Coinage to these tribes had no value unless it was perforated and could be slung around the neck as decoration. Paper money could not even be used in that way. What was in demand was something either to comfort the inner or adorn the outer man.

Knowing this, we had laid in at Manaos a large supply of coarse cotton cloth, fishhooks and line, needles and thread, machetes, axes, nails, and such things. These were the staples, the necessities, together with salt, dried beef, and *farinha*, a gritty sort of corn meal. But we also had our luxury counters. Before leaving New York we had spent many hours and dollars browsing in Woolworth's and like places and had purchased a goodly supply of inexpensive face powder and perfume, lipsticks, combs, rubber dolls that squeaked when pinched, harmonicas, mirrors, jewelry, and a host of other things. The quantity both in luxuries and necessities was large.

All night long, across the point on which our camp was situated, we heard the beating of drums, shrill yells, and the slap-slap of dancing, naked feet. The yelling grew louder as more and more cashiri was consumed, and long before dawn we heard the feet closer to our tent and the rustling of the grass and scrub as the Macusi drew nearer to the pay office.

We breakfasted at the crack of dawn, with scores of gloomy and fantastic-looking Indians watching every mouthful and clutching bow and arrow or blowgun. We gave the *tushagwa* his personal present, a single-barreled shotgun and a handful of shells, thereby winning his approval and favor. Then Don and I drew away the cloth that concealed the array of goods, while George, with a grand gesture of his arm like a ringmaster, directed their eyes toward the shelves. We could almost hear the surge of emotion.

One point was greatly in our favor. If some especially beautiful and unusual object from America del Norte became too popular and consequently began to run short, we could set an arbitrary value. Too much or too obvious manipulation might get us an arrow in our ribs; the *tushagwa* was supposed to see that his people got a square deal, but the severity of his demands depended upon the size of his personal bonus. Indeed, he acted almost like a "civilized" person!

Although cash and currency were unknown and unwanted by the Indians, five milreis worth of trade goods per day was the established rate of payment for rivermen and porters. Other unskilled labor received less. The milrei then was valued at about 13¢, but the things we were offering as payment had incredible worth for the Macusi. The rule of supply and demand was taking its rightful place in the scheme of things.

How those things gleamed and glimmered in the early morning sunlight — rubies and emeralds in the Woolworth rings, sparkling diamonds in the necklaces, pearls in the combs, and gold in the ten-cent mirrors and compacts—things they had never imagined before! They were going to be well paid, by their standards; by ours, they had done excellent work very cheaply. There were between 30 and 40 men, each with a pay check of about 35 milreis. Each of them had about five other men, women, and children watching avidly and yelling suggestions. Nothing was done quietly.

The first things they selected were red cloth for their breechcloths, some salt, and enough of the heavy cloth to make a frock for a woman and pair of trousers or a hammock. Needles and thread to sew the material together and perhaps a machete and some fishhooks and line usually completed the list of necessities. Then the warrior and his woman shopped around among the luxuries, not even understanding the use of some of them. Mirrors and harmonicas took hold at once. The Indians got immense pleasure from making hideous faces at themselves in the one and producing awful noises on the other. So great was the demand for plain mirrors that we had to increase the value of the compacts. They had cost the same as the mirrors, but the operation was not questioned, because the compacts had two sides and were obviously worth about twice as much!

Hotter and hotter we grew as the sun climbed higher, and stronger and stronger grew the smell, altered occasionally when a bottle of virulent perfume was opened and a few

Photo by T. Donald Carter

➤ PET BIRDS were among the few earthly possessions of these jungle Indians, who had lived all their lives close to nature

➤ GEORGE TATE adjusting his camera for a photograph of the triumphant rivermen, while Sunny, the mascot, waits for more exciting events

drops were spilled or applied to some copper-colored visage. Don and George acted as salesmen, pointing out the desirability of articles that were not moving well. I spent most of my time keeping Sunny and the village dogs apart. Our negotiations were conducted in the *lingua geral*, a mixture of Portuguese and Indian dialect, at the top of our respective voices so that we could hear each other above the yelping of dogs and Indians.

The lipsticks, the retractable type, were not understood at first and did not move. So George borrowed one of the women and posed her while Don did up her face. That started them going, and when one of the warriors hit on the idea of using one to freshen up his own war paint, gazing enraptured at himself in the mirror while he put a bright stripe across his nose and cheeks, a regular run on them started, and the women never had another chance. Up went the price, manipulated by us financiers, and the demand was transferred to some other article. Don, who can mimic birds and animals so naturally that they will themselves come to him, would squeeze a rubber doll and imitate the sound in such quick succession that even he became confused. This split the usually morose Indian faces into an almost amiable grin, which would have been a hearty belly-laugh in anybody else.

By the time all the Indians had been paid, and they and their brothers, fathers and mothers, sisters, cousins, and aunts had returned chattering to the village, we were exhausted and almost deafened by the babel of hoots, gurgles, grunts, screams, and quarrels that had been going on in our "bargain basement." The Brazilians and our two Peruvian Indians had prudently kept out of sight. Sunny had had about seven free-for-alls and felt that enough was enough for one day.

Photo by T. Donald Carter

Later, when we came to know the Macusi and other tribes better and realized that those things, so trivial to us, were sheer golden treasure to them, we began to think it over. Certainly we had not cheated them in any way. We, too, had splashed around in the Surumu, torn off fingernails and hunks of flesh against the rough sides of The Pig, disappeared under the water, and wondered where, if ever, we would come up again. We, too, had been paid, differently, of course, but not one bit more richly. Supply and demand had taken hold, and everybody was happy.

Born Alive

By N. J. Berrill

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Ewing Gallo

In our world of living creatures the greatest phenomenon of all is life itself, and with every creature the aim is the same—to perpetuate its kind. Here the author discusses the course that many animals have followed to ensure this

TO be born alive, living from the living, to wake in the world with warm blood already coursing, with a hunger for milk and maternal care awaiting—this is the heart of our mammalian creation. Our company includes the elephant and the mouse and all that can boast of hair, however sparse. And all must carry the navel mark of origin from the cradle to the grave.

The dangers, the pain, and the discomforts of birth and suckling sometimes overshadow the marvelous story of how this process developed. Our ancestors gained it arduously during a million centuries. It was not always this way. Before the time of flowers and seasons, our scaled and cold-blooded ancestors laid large shell-covered eggs and hid them in the earth. In some past infinitely more remote, almost invisible eggs were scattered in astronomical numbers in the sea.

All evolving life has had a choice: to disperse a multitude or care for a few. The aim is the same: to ensure that two or three shall survive to maturity to perpetuate the race. All reproduction has this essential end—the continuity of life in a world of transient organisms. It is our own good fortune that the complexity of our nature and the time of our duration allow enjoyment of mind and senses beyond the demands of propagation alone.

A large egg gives rise to a large embryo, and one which, when hatched or born, closely resembles its parent. Both the size and the habits of the young enhance its chances of survival. The larger an egg, the more likely it will grow up into a breeding adult; but in any case the hazards are great and catastrophe the common fate. The greater the number of eggs produced, the greater the chances that a few will reach maturity. Here lies the quandary, because the production of very large numbers of large eggs is far beyond the capacity of any living organism. Only a certain proportion of growth and tissue can be set aside for the formation of reproductive cells, and some evolutionary decision must be reached —whether to divide this portion into an almost infinite number of minute eggs or into a small number of relatively large eggs, or even one or two enormous ones. One method is not necessarily better than another. It depends upon many things. Of two flat-footed mollusks, the sea hare spawns a half-billion eggs a season, the whelk no more than a few hundred, but the outcome is the same—a population struggling for sheer existence. It is the nature of things to be different, and be-

NIMALS THAT GRAZE can usually protect selves from the meat eaters best by run- Young that can run soon after birth a better chance of keeping up with the when in danger

➤ BEAR CUBS are born under conditions of unusual safety. The female is in her den for the winter and may not even wake up when her young are born

HAMSTER photographed in its bur- with three youngsters: a scene typical g rodents. Rodents usually depend upon eclusion of their den or nest to protect blind and helpless young

Fisher photo

Ewing Galloway photo

tween the Many and the Large lies an infinitude of compromises—scope for novelty in an adventurous universe.

Evolution is essentially a progress from one discovery to another. What is evolved for one purpose becomes useful for another, and this has been the history of living births. Marine serpulid worms possess a calcareous tube that is primarily a protection for the adult worm, enabling it to survive in otherwise dangerously exposed places. Larger species, like those of *Serpula* and *Hydroides,* take no other advantage of this tube; but the small *Spirorbis,* common on rockweed the world over, uses the tube to protect the developing young until they can crawl out as miniature replicas of the parent. Apparently small species, producing fewer eggs, have greater need to take some care of them. The large species of the slipper limpet attach their egg cases to the rock surface. Dwarf species retain them within their mantle cavity.

One thing leads to another. Egg cases protect eggs and are the first step from the abandoned millions to the coddled few. Egg cases also keep out spermatozoa, so that fertilization of the eggs is not usually possible after the cases have been formed. Fertilization within the body of the parent, generally involving some form of copulation, therefore becomes characteristic, setting the stage for living births.

It has happened again and again. Among the cartilaginous fishes, many of the sharks and some skates produce a small number of large yolky eggs, about the size of a pigeon's egg. They are fertilized within the oviduct of the mother before the case or purse is formed around them. They are attached to weed or rock by horny filaments, and after a few months the purse splits open and a small shark emerges. In the nursehound, however, and in many larger sharks, the eggs are not laid. They enter the oviducts and are fertilized there in the usual manner, but the purses secreted around them are comparatively thin and delicate. Development proceeds, and after a time the horny envelope dissolves or is thrown off and the egg and embryo lie naked in the maternal tubes, to be born alive, maybe after a few months, maybe not until nearly two years have passed. Food for growth comes from the yolk of the egg and later from a yolk-sac placenta. In some rays, nourishment comes from hairlike projections on the wall of the uterus. These are drawn into the spiracles, or breathing vents, of the embryonic ray and provide the inborn fish with a milky fluid.

One further step is possible, and this has been taken by certain nurse sharks. As the embryo develops and the yolk diminishes, flat platelike structures develop, richly supplied with blood vessels. These convey not only maternal oxygen to the embryo but all the raw materials for growth as well. A placental organ is formed, which functions like the true placenta of mammals. Thus the developing young are not merely protected by retention with-

Ewing Galloway photo

➤ DURING the perilous period of infancy, the kid, like its mother, is a skillful rock climber. Through that talent it frequently evades attack by carnivorous animals

in the mother but are for the most part actually nourished internally, to be launched finally from her body as living, lithe images of herself, with much of their growth already attained.

Living births, however, have not led to dominant careers among primitive aquatic animals as they have among the land forms. They have not produced wider freedoms or greater adaptabilities. If anything, they have restricted the range of the animal and led to greater specializations. Those creatures of the sea that are truly emancipated by being born alive, creatures that in speed and range take the oceans for their own, are the dolphins, porpoises, and whales—mammals with an epic of creation and transformation behind them.

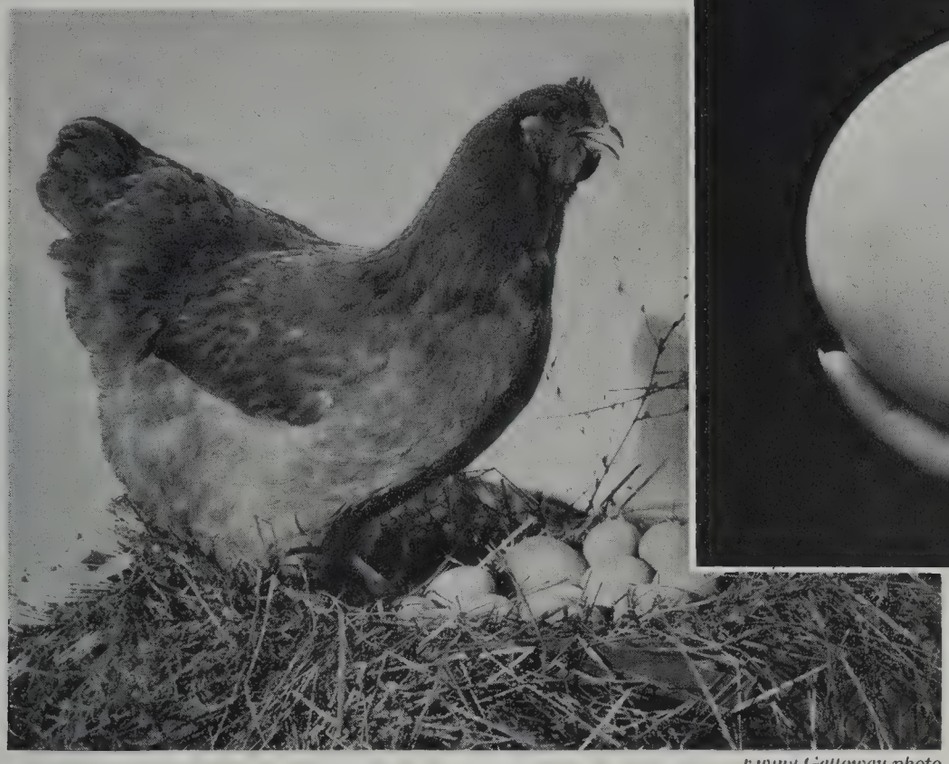
Bird photo

Mammalian history is essentially a story of the land. The fishes that successfully breathed the air of the coal forest and eventually came to walk the land as reptiles had a two-fold plasticity. In the course of untold generations, not only did lungs take the place of gills, and fins transform to legs, but eggs grew large and yolky, with calcareous shells enabling them to be laid on the land. With shells to be formed, fertilization had to come first. Internal fertilization and the initiation of development in the upper reaches of the oviduct became mandatory. This is the reptilian mode, and apart from the question of heat and warm blood, it is that of the birds as well. The emancipation of the egg from its need to develop in water was an epochal event in the evolution of life.

➤ WALRUSES UP FOR AIR: a study in symm in a zoo pool. Full-fledged mammals de their marine life, walruses are born alive whales, porpoises, and dolphins. They r nize few enemies among the other crea of the sea, who scatter millions of egg the hope that a few may survive

A.M.N.H. photo

➤ HUMMINGBIRD EGG and ostrich egg: extremes in a method of reproduction that has long been successful. Increasingly dry climate is thought to have caused the development of drought-resistant shells on eggs that were previously soft, thus enabling them to survive out of water



Ewing Galloway photo

▲ THE HEN has become such an "egg-laying machine" that man has taken her under his protection. She lays far more eggs than are needed for survival

The first transformation, from an egg similar to a frog's to one very much like a hen's, was part of a response to environmental changes. The carboniferous forests and swamps were shrinking; the land was growing drier, with increasing exposure to light and air. The later transformation—the retention of the egg within some part of the body, with subsequent loss of the shell and yolk—was equally a response to an environmental challenge.

Early in the evolutionary rise of reptiles, the climate of the earth became colder, and about the same time the first mammal-like forms appeared. When the climate grew warm again and the reptiles reached their culmination, these mammalian progenitors took a low and humble place. They later showed that the meek could inherit the earth, but our only surviving representatives of those early egg-laying mammals are the rather specialized platypus and spiny anteater. These two have never graduated from egg-laying, but they show a solicitude for their eggs more acute than that of reptiles or even birds.

The habits of the spiny anteater are especially illuminating. It does not bury its solitary egg and leave it behind as most reptiles do. Nor does it lay it in a nest that would hold the parent to one locality. It carries the egg in folds of the pubic skin, practically a pouch, imparting to it both protection and a degree of warmth from the maternal body, without sacrifice of daily travel. Not only this, but incubation of the egg actually starts within the uterus of the mother and continues there from two to four weeks. That is, a shelled, yolky egg is retained within the parent for a considerable part of its period of development and is thereafter kept safely within a skin pouch. In a sense, the embryo is born alive, even though the egg itself is unchanged and is still the box-shell that freed the four-legged migrants from water to roam the surface of the earth. Even milk glands are already present in the mother to carry young life a little further on its journey through time. The spiny anteater's only living relative, the platypus, produces very similar eggs but lays them in a nest in an underground burrow. This custom is probably necessary as a consequence of the great amount of time the platypus spends in or under the water, for the eggs would be quickly killed by submersion.

The true pouched mammals, the marsupials, took the next step. If a developing egg remains within the uterus of the mother, a calcareous shell is an unnecessary protection. It is, if anything, an obstacle to "respiration." Thus the shell was eliminated by the marsupials. With its going, maternal nourishment through embryonic membranes became possible. Consequently, only a very minimum of egg yolk is actually necessary, and we find shell-less and virtually yolkless eggs, no more than one-sixth of a millimeter across, developing in the uterus to a stage recognizable as a mammal. When the little creature is born, it is sufficiently advanced to fumble its way to the all-essential milk of the mother.

The opossum of North and Cen-

Acme photo

KANGAROOS and other pouched animals are ill-equipped to nourish the young in the mother's womb. Hence they are born in an "under-developed" condition so they can take advantage of her milk supply

tral America is fairly typical of the marsupials. Baby opossums are born after thirteen days in the uterus. Each is about the size of a hornet. Most of the internal organs can be plainly seen through the transparent wall of the body. Yet they have to find their own way, without the help of the mother, through the forest of fur on her abdomen, into the small opening of the pouch.

Often as many as eighteen young are born at a time, with about twelve teats to support them, so that one-third—the slowest, the weakest, or the latest—are doomed from the start. The more fortunate hang on to the teats for dear life and within a week increase their weight tenfold. After two months or so, when about the size of mice, they start taking rides on their mother's back. They leave her for good when they are about three months old.

The reason why the young of these pouched animals have to get to the milk supply is that they have no special arrangement for getting nourishment in the mother's womb. At one time pouched animals overran the earth. But when other mammals developed the vascular membrane known as the placenta, the pouched mammals were swept from the scene, except for those that have taken to the trees in the Americas or found themselves in the sanctuary of water-bound Australasia. The placental mammals took the last step with regard to the close interlocking of embryo and mother. The placenta took the place of the yolk sac of earlier animals and became the organ that controls and transmits all of the necessary exchanges between the blood of the mother and the blood of the embryo. With this new invention, the period of gestation, or nourishment within the womb, could become as long as the subsequent period of suckling. In a general way the two periods are fairly well balanced for most present-day mammals, including man. The combination of uterine nourishment and suckling has placed the true mammals at the top of the pyramid of life, and man, who has made the most of this combination, is inclined to feel that the rest of the pyramid exists to support him.

Small mammals, such as rodents, usually produce litters of up to a dozen blind and helpless young. Large mammals generally produce a single offspring. There are, of course, exceptions; but most large mammals live for a good many years. They are relatively immune from attack by small ones and can readily maintain their population at this rate. Small mammals are often the prey of larger ones, especially before man and his gun upset the balance of nature; therefore, much larger numbers have been necessary for the maintenance of their kind. On the other hand, their quick maturity, incessant breeding, and rapid development can, if unchecked, lead to fantastic situations. A single pair of house rats, if allowed unlimited food, space, and safety, could give rise in only three years to 350 million, for they have large litters of nine or ten, with three to six litters each year, and they start breeding when three or four months old.

This is merely the *potential* reproduction. Natural enemies normally keep numbers in check, and the food supply finally calls a halt if nothing else does. Lemmings can breed as intensively as any rat and are less restrained. Every few years, as the numbers reach their peak, the plants on which they feed disappear under the onslaught of millions of small jaws. Then starvation, lack of space, and fouled runways set off in some manner the famous suicidal migration to the coast and a watery grave.

In all such litters, the offspring are not like identical twins, which come from a single egg. As many eggs are fertilized as there are young, and they are no more alike than brothers and sisters except that they are of the same age. The armadillo, on the other hand, produces a litter from a single egg, the members of which are identical. In the Nine-banded armadillo, the single fertilized egg gives rise to four embryos shortly after the beginning of development, so the birth of identical quadruplets is the rule and not the great exception. In the closely related Mulita armadillo, as many as twelve identical twins develop from a solitary egg.

In each of these instances, a single placenta is formed, to which the individual cords of all the embryos are attached. In ordinary multiple births like those of cats and mice, each embryo forms its own placenta. The same difference distinguishes *identical* human twins from *fraternal* twins.

Being born alive, even from a true placental mammal, can mean one of a number of things. The life that must be followed immediately after birth profoundly influences the nature of the offspring. The large grazing mammals that can escape from their enemies only by running cannot afford to have small, helpless young. The more alert the young are and the more able to run shortly after birth, the better their chances of keeping with the mother and the herd when in danger. Suckling is as necessary as ever, but the one or two offspring born to most of the hoofed mammals are as much like their fleet-footed parents as it is possible for the newly born to be. They are born large and long-legged—as large as the mother can bear. The pigs, however, are not built to develop great speed. Their answer to the problem of survival is more like that of smaller mammals, with the production of rather large litters, out of which some may survive to maturity. Their chances of survival are also increased by the fact that a wild boar or sow will put up a formidable fight to protect the young.

The largest animals of the land—the elephant, the rhinoceros, and the hippopotamus—find security in their size and their thick hides. They have little need to run. Their size and strength are also a protection to their young as long as they can keep together. But they must keep moving to keep eating, and so again we find the offspring extremely far grown at the time of birth. A single embryo develops at one time, taking eighteen months to complete its course in the rhinoceros and twenty-one months in the elephant. The calves can walk at the side of the mother virtually from the time of birth. They are already so big that only the largest carnivores can safely attack them, and the concerted action of a herd may give the calves a great deal of protection.

Ewing Galloway photo

CAMELS can subsist farther from water than most of their enemies, but in a pinch the young one can keep up quite well with its long-legged mother

Such giants are exceptional. Most mammals give protection to their young until some time after weaning by keeping them in a safe lair or burrow. Breeding is usually an annual routine, either in spring or fall. While a long, slow process of gestation in the womb has its advantages, the period must not exceed a year if the annual cycle is to be maintained. Otherwise the breeding season is reduced to no more than once in two years. When paternal affections are less than the attraction of a good meal, rather difficult situations may arise. The fisher shows this very well. This fox-sized relative of the weasel is neither a fisher nor a fish-eater but

Continued on page 431

DEATH MASKS in Lava

A forest is preserved by the same hand that destroyed it

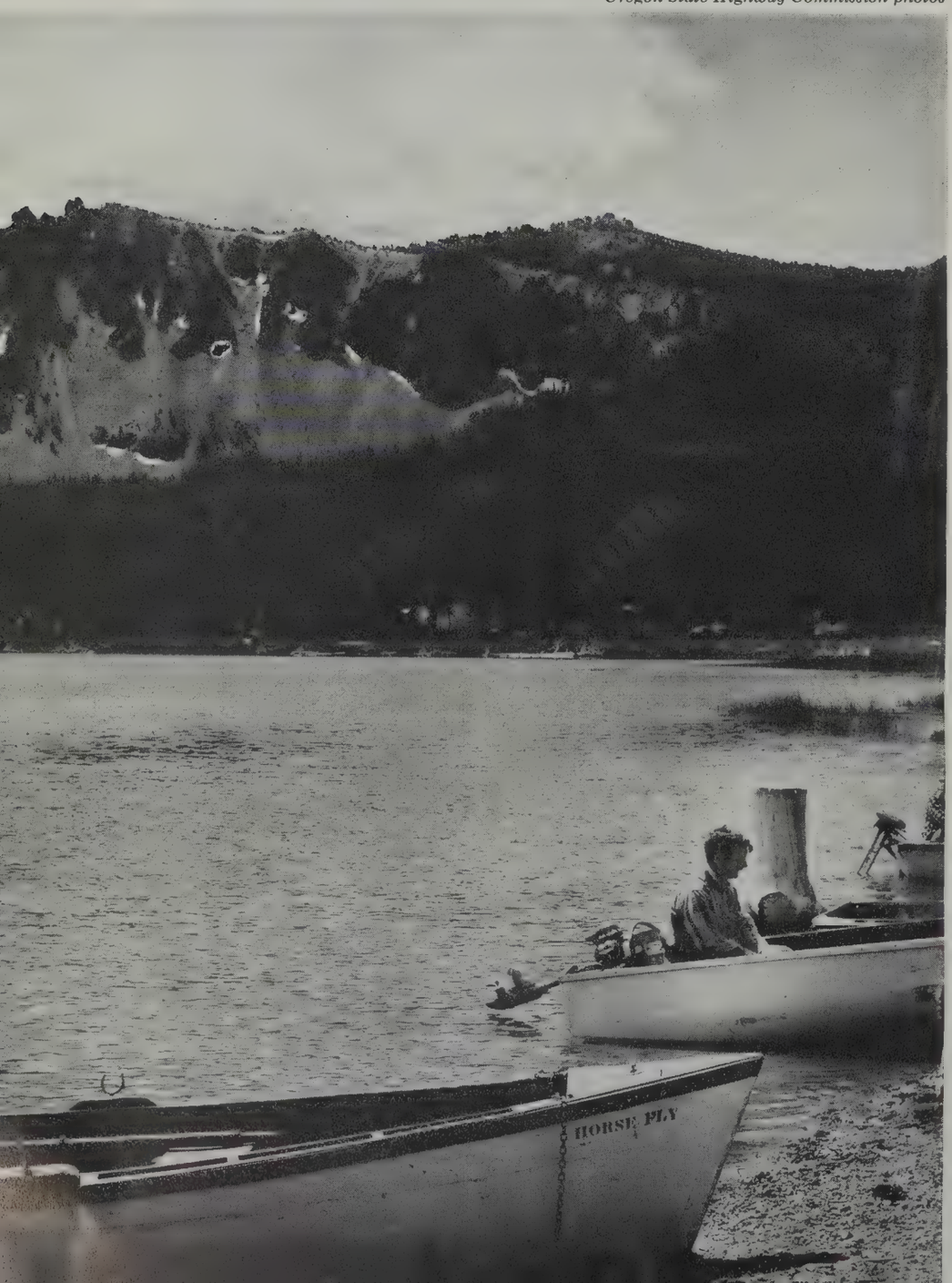
By DOLORES BUTTERFIELD JEFFORDS

TREES have been buried alive, carbonized, petrified, and otherwise treated roughly by volcanoes throughout prehistoric ages. But it remained for a comparatively modern volcano in the Cascade Mountains of Oregon to destroy a forest while preserving in lava remarkably perfect death masks, so to speak, of the vanished trees.

Lava Cast Forest, adjacent to the Deschutes Game Refuge in Deschutes National Forest, is a creation of one of the last eruptions of Newberry Crater. This extinct volcano was discovered in 1826 and was later named for Dr. John Strong Newberry, a geologist of note, a physician, and a member of the Williamson Expedition, which explored central Oregon in 1855. Al-

▼ PAULINA LAKE, in central Oregon, was formed after volcanic activities subsided. A portion of the Newberry crater wall is in the background. If all sections of the crater wall had remained intact, a single lake, up to 2000 feet deep, might have been formed in the crater

Oregon State Highway Commission photos



▼ THIS TUNNEL marks the site once lay a prehistoric log. When th

though its greatest activity occurred during the Pleistocene Age, the volcano erupted spasmodically up to within the last few thousand years.

The cone of this great mountain, like that of its famous neighbor to the south, Mount Mazama, collapsed into its own crater. After the collapse, spasmodic eruptions continued, the lava pouring over the rim of the crater and down the slopes.

Below this vast mountain, on its northwestern slope, lies Lava Cast Forest, on a road that runs east from U. S. Highway 97, at the northern edge of the Game Refuge. Though called a forest, it is a treeless waste, a jumble of black basaltic lava, rough and broken, in the midst of which is a little geological museum. Centuries ago the forest that stood there was inundated to a height of some 20 feet by a flood of lava. The charred, dead trees disappeared, but the cooled lava retained their shape, size, and even the imprint of their bark. In an area of several square miles covered by this flow—which is superimposed upon other much older flows—there are a great number of these cylindrical lava casts, some prone, some upright, many of fragmentary length, others barely rising above the surrounding rubble—all mutely telling the story of their ancient tragedy.

Yet all about the lava wastes, and even on the forbidding ramparts of Newberry Crater itself, new vegetation is establishing itself—slowly but persistently gaining ground. It is almost as if Nature had smashed things up in an uncontrolled fit of temper and then, dismayed at the havoc and filled with contrition, had set about making amends and repairs, patiently reclothing with verdure the seared desolation. In time—whether it be centuries or millenniums—the evergreen forests will once more encircle the black slopes of the dead volcano.

engulfed by molten lava, the wood
ned away, leaving this perfect cast

DEATH MASKS IN LAVA

▼ A SHATTERED CAST: epitaph to a one-time forest patriarch. In the background is new growth—a promise that evergreen forests may one day return to the slopes of the dead volcano

◀ THE MARMOT BOWL in winter. Beneath this blanket of deep snow the marmot village lies sleeping. After seven and a half months in darkness the animals will emerge

Grumpy. Down on the lip of the drop-off into Griff Creek basin were the Twins. On the other side, on the slanting drop-off into the Marmot Bowl, we found the Babies. Then there were the *hoi polloi* of marmots, the general run, whose burrows filled the space between our favorites.

THE TRUE MOUNTAINEER

No one glimpsing a rare marmot in the Olympics today would dream that once they were the most playful, noisy, and sociable of wild animals in their peaceful villages above the clouds

By LOIS CRISLER

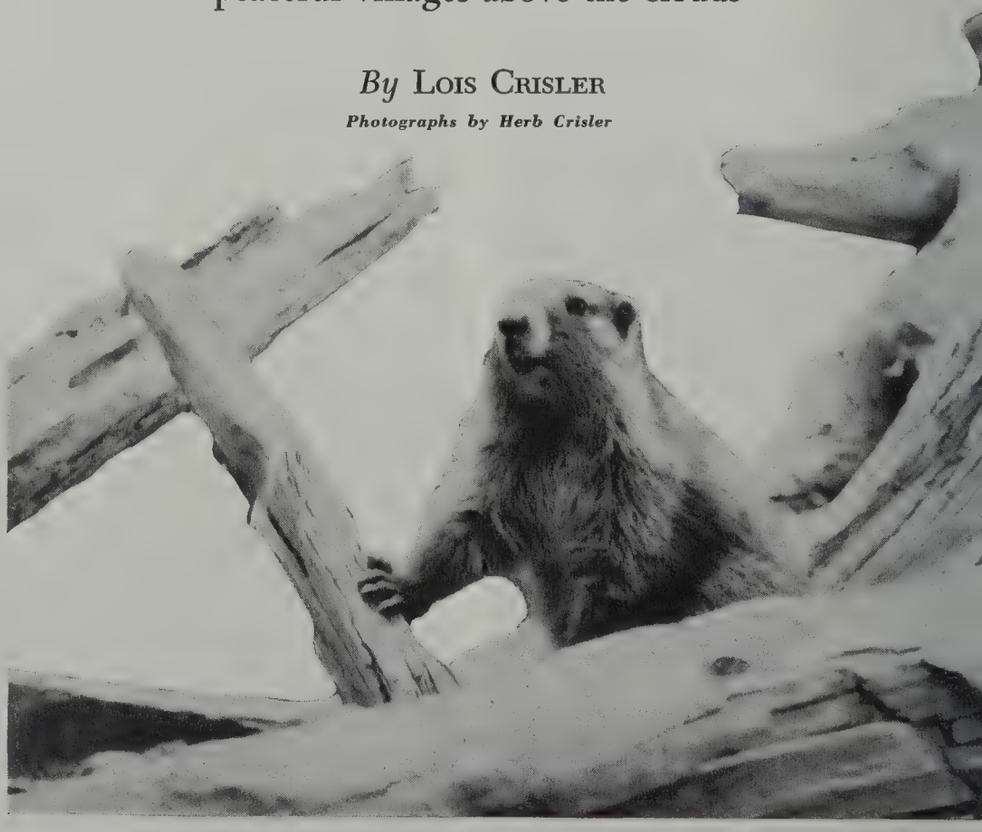
Photographs by Herb Crisler

THE marmot is less cut out to be tragic than almost any other animal. For a tragic figure I would pick a big bull elk, an antlered king, going off into the mists of death, proud and alone. Yet it is the furry, romping, wholehearted, stubby little whistling marmot who has seemed more ominously shrouded with the tragic veil.

I saw him in his golden age and did not know it. I lived with the marmot for a year in a little secluded backwater of the Olympic Mountains in Washington State and got well acquainted with him and his ways. I did not know this was only a pool left in the ebb tide of his glory. I had to learn how he lived in his golden age to feel the pathos, the strangely tragic status of this unconsciously comic little animal.

For most of a year my husband Cris and I lived alone in a lookout on the tip of a mountain more than a perpendicular mile above the salt blue Strait of Juan de Fuca. We were up in a choppy sea of mountains, with the white heads of the Olympics on three sides of us. Down from the lonely conelike tip of Hurricane, our own peak, swept alpine meadows that were a whistling metropolis of the vanishing marmot.

Cris and I, in a glass-girt lookout, were the only human beings for fifteen miles. Our neighbors were the marmots. On the rock in front of the lookout door was Molly



▲ "WANNA PLAY?" this marmot seems to ask. At work, the marmot is industrious, but at play his elflike, comic personality really finds expression

There were plenty of other animals around — snowshoe rabbits, deer, chipmunks, bear, even elk. Cougar crossed the mountain pass below us to the north. The coyote gave us an equally wide berth but left its cautious tracks down the ridge to the east. All these we saw at intervals.

But the marmots were property holders, with investments of labor. When we wanted to see a marmot, we had only to look out one of the 24 windows belting our 13 by 13 foot living space. When a marmot whistled, we looked too, just as the wild things did. We wanted to see who had upset the marmot—a bear, wildcat, or coyote.

The first time I began really to get acquainted with the marmots, Cris and I stood and laughed for ten minutes. Two of them were playing a game on the rounding lip of their burrow, while a third watched from the hillside above. The game was complex. It seemed to be a mixture of boxing and rolling downhill. I could not figure out which was the climax, to the marmots. The two tawny, fur-overcoated players would stand on their hind legs boxing. Then they would haul off and wait alertly for an instant, then the furry chests would fly together in a clinch. A grunt, sometimes a squeak that certainly meant, "Ouch, no fair biting," then the furry pair would tumble over and roll headlong down the side of the burrow, which was already worn bare.

To us this was the funniest part of the game—their spirit of abandonment in that headfirst, end-over-end tumble. The marmots couldn't wait to get going again. They would leap to their feet, traveling this time in normal marmot fashion, on all fours, and fly to the lip again, one ascending on each side. There they would rise on hind feet and gravely and eagerly waddle toward each other, to slap, to clinch, to make the roll all over again.

That roll, I believe, was the cream of it—a double roll and sometimes a triple; for the third marmot, which seemed to be the mother, could not resist jumping down, throwing her furry body onto the boxers, and rolling over and over with them in a reckless heap of fur down the worn hillside.

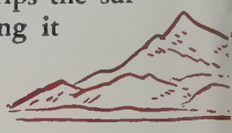
We have watched marmots coast on snow. Free movement that costs no work is fascinating to a wild animal. They have no sled, no skis. We have watched a marmot deliberately shove off and coast on its rump down the soft spring snow, or throw on the brakes when running down the snow and skid for ten feet.

Probably no adult wild animal loves a romp more than a marmot or indulges in one oftener. It was a laughing village that we watched, spread out below our lookout windows. The apparently sober-minded marmots were good for dropping work and putting on a foot race any time. If one overtook the other, they rose to box. Their supple bodies stood up slim and smooth as those of ballet dancers. They pulled high, sank low, and clinched, in a quaint pattern of movement sometimes as rhythmic as a dance.

The invitation to the dance was given by one furry paw-pat on the shoulder of a possible partner. The invitation was never scorned. The two taut, erect bodies formed a perfect arch, noses and forepaws together. Then, pushing away with their paws, each marmot curved backward, heads backward too! They swung together and their buck teeth clicked—the castenets! Then one would break away and

▼ The Olympic marmots are the largest, weighing fifteen pounds or more. From the front, they look deceivingly bulky, but from the side, when the marmot is in motion, the body shows up skimpy and narrow

A MARMOT LOOKOUT: for basking in the sun and for viewing the world roundabout. The marmot ascends rocks as easily as cats climb trees, but he grips the surface instead of clawing it



PROBABLY no adult wild animal loves to romp more than a marmot. These apparently sober-minded animals are good for dropping work and putting on a foot race any time

SETTING UP "SHOP" beside some marmot burrows. Hibernation begins in September, and the sleepy animals reappear sometime in May

run, hissing if the other almost caught him. Boxing or square dancing, the marmots loved it.

These marmots in the Olympics are the largest—bigger than a tomcat and weighing fifteen pounds or more. From the front the marmot looks deceivingly bulky. His hide seems to hang in folds over his shoulders, like a fur cape. But from the side, as he stalks away with his stiff-legged marmot walk, his body shows up skimpy and narrow, with neither chest nor stomach curves.

One purely marmot touch is his gait. The marmot moves fast, with quick listening pauses. After each pause he gives himself the green light by flipping his tail up over his spine—a stop-and-go signal to himself!

Marmots are rodents, big cousins of the woodchuck—not like cats, not like dogs. They ripple themselves against a rock, stroking their fur apparently with a cat's pleasure, but when they climb, it is not like a cat. They ascend craggy rocks as easily as cats climb trees, but they grip instead of clawing. All four of their black-fingered paws are as clever as little hands.

They conduct "post offices" but not as dogs do. The marmot stands up by a post and with his two long, curved, rodent upper teeth, chisels a tooth mark as high as he can reach —his letter to the next marmot. Two or three of the small gray telephone poles leading up to our lookout had been undercut by them in this way.

Most people think marmots make only one sound—the famous warning whistle. But actually they can utter most of the sounds small dogs or cats can make. They mew, growl, hiss, and bark. When a marmot finds itself hopelessly penned, with no exit, it cries like a baby.

The whistle of the marmot sounds human. A party of the Seattle Mountaineers Club were being guided across a snow field in the fog by their leader's police whistle. They

▲ HOME of the true mountaineer: the Olympic Mountains. Here, above timber line, the marmots live the year round

became utterly confused when the marmots also began giving come-ahead or wait signals.

The marmot whistles with its whole self, like a sea gull or a bull elk. Its sloping shoulders, in the loose fur overcoat, shrug together. The whistle is for intruders. If one marmot spies an intruder at a safe distance, he whistles. Then all the marmots fly to their burrows, hind ends flopping ridiculously, and pause on the lip to look for the enemy. If he is too close, they drop out of sight without another peep. If he is a safe distance away, then one or more of the marmots, standing erect on the mound at the lip of the burrows, settle into a rhythmic series of whistles until their perturbation dies down.

But most interesting of all are the cat-and-dog discussions among themselves, when the marmots think they are alone. On two successive days Cris and I watched two marmots apparently trying to dislodge an intruder from a crevice at the back of a small platform on the side of a crag. The intruder could back into the crevice far enough so that they could not drag him out. The two whirled around, reached for him, climbed over the rocks looking for a back entrance to his hide-out, then leaped down at the front of it. The first day, the penned-in one cried. The second day it growled. From all three came a loud medley of sounds — mewing, growling, fussing.

In June, marmot life is at its peak. The village is wide-awake after hibernation, and there is plenty of juicy food in the alpine meadows. The animals work with passionate intentness, cutting hay and carrying it in long whiskery chopfuls to the burrow to reline it, dragging up damp worn winter hay from inside and dumping it off the lip of the burrow.

The marmot is a vegetarian, and he finds many a tidbit even close to the snow. He sends the earth flying up in a stream from behind his paws as he burrows for succulent roots or digs up shining white wild onions by the dozen. He stands up, holds the bulb in his "hands" to nibble off the rootlets and sometimes even to eat the onion, though he often discards it. The alpine flowers that are spread to the sky in fabulous gardens above timber line are also devoured by this little clown—rosy douglasia, the delicate, red-veined white miner's lettuce, and honey-hearted mountain phlox. His chops work with feverish speed. He stands up to grip the blue lupine spikes and pull them to him to eat. He nibbles lichens off the sun-facing rocks.

One of the strangest, most elfin things I ever saw was Cris playing with the wild marmots one June evening. For two weeks he had done nothing but film marmots, from breakfast or before till the late afternoon sunlight was too dim for color movies. The Twins were his standby. They got to know him.

The sun was near setting, and I knew I would not be disturbing his subjects when I went to look for Cris. I heard a scrambling, a rush from the alpine fir scrub beyond the Twin's dugouts, and a low exclamation from Cris. I could not see a thing. Then the soft rush again, a half-voiced marmot squeak, a grunt from Cris, and into the shadowy circlet of meadow they came, none of them knowing I was around. I stood still. All three were chasing each other. It looked like the good old marmot game of tag, varied into hide-and-seek. Cris jumped to one side, the marmots darted under the scrub on the other. He made a little move toward them. They ran a foot or two farther, then turned and went pellmell toward Cris again, quartering past him more intent on each other but in some tolerant, elfin way accepting the man as part of the setup.

Marmots are peaceful. Once only we saw Molly Grumpy fight. The battle was for her property rights, and she fought hard. Naturally an animal with a burrow, grazing meadow, dodge holes, and lookout rock has a sense of property. In the spring, when the marmots first come out of hibernation, grazing boundaries have to be established, and there are a few intense battles, like that of Molly whipping out a greedy intruder.

Molly Grumpy spent hours on her favorite rock near our own door. When she let me walk right past her without dropping out of sight, I felt as pleased as if I had made an A on examinations. She relaxed onto the top of the rock, flattening her body over it like a small tawny fur rug. But she had her limit of toleration. If I let water hiss on the hot stove or clattered a pan in the vast silence of the lonely mountaintop, she whirled around abruptly and directed her attention to me.

On cold windy days, she might sit hunched like a cat for an hour

at a time. Poor days for relaxing out-of-doors, I thought. But on these days she thrilled me. The small blunt triangle of her head was reared against the vast blue triangle of Mt. Angeles. Mists fumed up white from the canyon below and drove past her. Her short fur blew up backward along her spine from the wind off the Pacific—an indomitable little mountaineer whom rough weather never drove "downstairs." Above timber line was her home, twelve months of the year.

In the winter when I skied down into the Marmot Bowl and stood silent on my skis, it gave me an uncanny feeling to realize that beneath my feet were these living animals. Around me was the barren, bitter beauty of mountain winter. The unbroken snow rolled deep over the burrows. There was a fine glitter in the air from sparkles of snow blowing off the cornices along the mountain ridges.

Our own winter at the lookout was lonely. Three impossible sounds were a rooster crowing, an automobile horn, the knock of a human being at our storm door. Winter was dramatic. It was a fight. Spring was the difficult time, for spring was monotonous. It never came. I was tensed to endure the winter, but then I wanted change. Yet still the storms came, the winds blew, the clouds that in winter had preferred to pile out over the strait now hugged the mountain ranges, and through their torn places I looked down with wistful longing at the rich green, 4000 feet below. Down there it was warm. Down there the sun shone and gardens were starting.

But up in our thin, lonely world of blue and white we one day had one of the dramatic experiences of our lives. We saw the marmots dehibernate.

Cris was on night duty. I went off at 1:00 A. M. and usually slept till 9:30. But on the eighth of May, Cris could not wait for me to awaken. He came down to the bedroom, which was in a shed below the lookout. He is a very soft-spoken man, but now there was excited pleasure in his every move as he said casually, "We got company."

From fast asleep I sat up wide-awake: "Who? Where?" He smiled a little and pointed out the window. Down on the white expanse of the marmot meadow were round black holes. Near each hole sat one or two dopey little dark figures. The marmots were out!

Cris told me that the holes had been there when it first began to get light. The little beasts had dug themselves out between evening and dawn, presumably because this was the first warm night of spring. We kept our eyes on those dopey little figures as we got breakfast and ate. They hopped around a little, changed position, and even moved

▼ SOCIALIZING IN THE SUN. Marmots can utter most of the sounds that small cats and dogs can make. They mew, growl, hiss, and bark; and when hopelessly trapped they cry like a baby

➤ A MARMOT HALTS for warning sounds. His gait is fast, with quick listening pauses, after which he gives himself the green light by flipping his tail over his spine

BOXING, marmot style. They pull gh, sink low, and clinch, in a quaint ttern of movement sometimes as rhyth-c as a dance

to the other side of the burrow. But mostly they just sat as if drugged. About 10:00 A. M., they went in and did not reappear till the next day. We went down to investigate the holes. We estimated that in one place the marmots had dug up through ten feet of snow.

These marmots had last appeared the previous fall, on September 26, when the mountain meadow was still hot and sunny but devoid of moisture. Every juicy green blade had been stripped by grasshoppers or had dried up. For over seven and a half months these marmots had not been seen by human eyes.

It was a day or two more before the marmots in deep-snowed Griff Creek basin, just below us to the north, came out, and before Molly Grumpy emerged from her den beneath her lookout rock. Daily the black circles of the holes widened, the snow level sank. But on May 18, I could still dangle my ski pole by the strap, with my wrist at snow level, and the point barely touched ground down inside the perpendicular snow funnel. Four feet eight inches!

Only gradually did the marmots come to life. But after a few days they were briskly establishing snow trails—up from Griff Creek basin through a gap they made in the cornice, to reach some early meadow grazing on the south side of the lookout, and from each burrow to reach their own favorite resting lookouts and dodge holes. The snow trails coincided with the permanent trails now thawing and coming to light, worn four inches wide among the tufts of meadow grass.

These cheerful marmot villages near our lookout were, as I say, a backwater left from their golden age. When we left the lookout and went into the interior of the Olympic wilderness, we discovered that the marmots there were in trouble. The interior of the Olympics used to be a sea of marmots. Forest lookout men shot them for sport or as targets. One claimed to have shot 300 in one summer. And still they were plentiful. Hunters shot them because they alerted the deer. We saw a marmot cheat a hawk out of a grouse by whistling the alarm just as the hawk dived. The grouse made it to cover by the down of her feathers!

But for nine successive summers now, from June to October, Cris and I have ranged beyond the trails in the interior of the Olympics. We see scores of empty marmot burrows—bushes taking root at the mouths, cobwebs across the doorways. But in a whole summer we see no more than two or three marmots in the interior. They are in desolate places where the snow lies especially late and where vegetation is not abundant. They are silent and playless. No one glimpsing a rare marmot now would dream that once they were the most playful, noisy, and sociable of wild animals, in peaceful villages above the clouds.

Villages persist near places frequented by human beings — near lookouts and ski areas. But in the interior, the last village we saw was a small one in 1945. We saw a coyote a mile away. Since then there have been no more marmots there, while coyote signs are frequent, and each summer we glimpse one or two coyotes in that territory.

What is happening to the marmots? If all the marmots in the Olympics were disappearing, one might suspect an epidemic. But they do not die out near lookouts and ski areas, which the wary coyote shuns. Probably bear, wildcat, cougar, hawks, wolves will all take a marmot if they can get him. But these are all his traditional enemies,

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and he prospered in spite of them for centuries.

I had a rare experience once. I watched a wolf hunting marmots. The marmots did all right. The wolf must have been a young one. He had utterly no strategy. He saw a meal standing bolt upright, a yellow post at the mouth of a burrow, advertising itself by whistling. It looked so permanent and so accessible that the wolf made a rush at it. Just as he neared his meal, it tumbled out of sight. The whistle was taken up from other parts. The whole marmot community was in an uproar. Meals to the right of him, meals to the left, all bidding for attention, but not a single meal to eat. The wolf rushed wildly from one to another of the widely-spaced holes till he must have been exhausted—but still hungry.

We may have seen a cougar hunting marmots once. It was in the summer of 1948, and we had discovered two marmots together in the interior of the Olympics for the first time since 1945. They were in a wild, high basin off Mt. Ferry. We saw them in July and again when we passed that way in August. In September as we came down off the snow into the basin, we were looking for our marmots when, at almost the same instant, Cris and I saw a cougar near their burrow. Apparently it had been keeping a menacing vigil by the burrow. Surprised by us, it stood with its forepaws against the rock crag near the marmot hole, its head turned over its shoulder watching us. The next minute it swallowed the mountainside with great leaps and disappeared over the sky line. Two marmots alone are very vulnerable.

In their villages, marmots are fairly safe. Their safety diminishes by geometric progression with the demise of each potential lookout, because they may have to run 100 yards or more for food. And if intercepted by a predator away from the burrow, alas—they cannot run very fast.

The first week of July, 1947, we camped near a lookout rock and den of a marmot that must have come out of hibernation quite recently. His tawny fur still carried a ragged brown band of the hibernation coat. Late-lying snow surrounded his rock and covered the slopes below it. The marmot had to run quite a distance over snow and rocks to reach a patch of vegetation on the ridge above. For the entire week we camped there, we saw him daily. Though he was silent, he was trusting. A month later we camped in the same place, but there was no sign of the marmot. There was fresh coyote spoor by the lookout rock.

The coyote is not native to the Olympics; it was first noted there in the early 1920's.

Three things we notice: the appearance of coyotes in territory new to them; the simultaneous disappearance of marmots, rabbits, and grouse; then "deadness," with neither coyote nor marmots.

Will the coyote eat himself out of the country? He ranges far and is versatile, eating grasshoppers, green huckleberries, and even their blossoms, though his flanks stick together on that famine fare. He is probably in the Olympics to stay.

Is a Government hunter the solution? The gossip behind the scenes is that with trap or poison the Government hunter first kills out every other smaller animal in the country before he gets the wily coyote. If this is the case, the remedy is certainly worse than the disease.

The October after we left the lookout, Cris and I were in the interior, beyond the trails, hurrying along a ridge above the dark blue canyon of the Hoh River, 4000 feet below. Clouds were low over the glaciers on the Olympus Range opposite us, and we were anxious to get out of the mountains. We saw a marmot, erect on the sky-line ridge ahead of us. He was watching us but in silence, motionless. There was something strangely pitiful about him, and I could not tell what it was. Surely, I thought, his companions must already have gone into hibernation. This one must be late; he will "go in" shortly. But there were no used holes near by. He was silent, alone. He seemed to be traveling.

NATURE'S Record Fasters

Nature's champion fasters make a reducing diet look like a feast

By FRANK W. LANE

I'VE undergone three fasts in my life—one of fifteen, another of nineteen, and a third of thirty-two days. Generally I existed on fruit and vegetable juices diluted in water, but during the longest fast I lived for a fortnight on water only. At the end of the 32 days I had lost 27 of my original 130-odd pounds. Incidentally, at no time was I confined to bed, and during most of the time I was able to go out for walks.

After these experiences of fasting I thought I knew something about the subject, but I have since learned that, compared with some of Nature's champion fasters, I hardly know what the word means. My fast was, at most, only partial (I had water and nourishing juices) and was reckoned in days. There are some creatures of the wild whose periods of fasting are reckoned in years, and during that time they don't even have a sip of water—let alone a drop of carrot or grape juice!

Here it is necessary to deal with the extravagant stories that occasionally crop up concerning frogs and toads that are said to be found by workmen while demolishing old buildings. The heading of one such account in front of me now reads: "Toad Set in Concrete 20 Years Ago Rolls Out, Alive and Well." Another newspaper report I have seen alleges that a frog was found in a 60-year-old brick wall. The workmen declared that they could see no way for the frog to have gotten there unless it had been there when the wall was erected.

I say without hesitation that all reports of toads or frogs living for 60, 20, or any number of years entombed in ancient buildings, concrete blocks, brick walls, or what have you, are untrue. Experimental biologists know how difficult it is to keep frogs and toads alive in captivity even under the best laboratory conditions. A constant source of moisture is vital to keep them alive. In dry air they die in a few hours. How impossible, then, would it be for them to live for years (not to mention decades) under the unnatural conditions of incarceration in some impermeable substance from which water, food, and air were excluded!

If reinforcement of these arguments were necessary, it is provided by the experiments carried out as long ago as 1825 by the Rev. W. Buckland, Professor of Geology and Mineralogy at Oxford, England. He procured a dozen boxes of sandstone fitted with airtight glass covers, and an equal number made of limestone. Each box was provided with a toad, and then all were buried under three feet of earth.

Thirteen months later the boxes were dug up. All the toads in the sandstone boxes were quite dead. In the porous limestone boxes a few toads were still alive. The surviving toads were again buried, but before the end of the second year they were all dead. As the result of these and other experiments involving wood, the Rev. W. Buckland concluded: "There is a want of sufficiently minute and accurate observation in those so frequently recorded cases where toads are said to be found alive within blocks of stone and wood, in cavities that had no communication whatever with the external air."

How, then, is the persistence of the myth of the "walled-up" frog and toad to be accounted for? Doris M. Cochran of the U.S. National Museum, who has made a study of this subject, explains that these creatures, especially toads, can and do persistently hide in small holes and crevices. To a toad roaming about at dusk, the bottom of a deep excavation has no doubt often seemed an ideal spot. The summer's heat and dryness has probably often driven toads and frogs to burrow into chinks under old walls or to wander down the entrance of mines into the dark, cool, and moist surroundings—conditions imperatively necessary to an amphibian's existence.

And when the poor creature is found by a none-too-critical workman, and the story is written up by an all-too-credulous reporter, there is another entombed toad story to titillate the fancy of the newspaper reader and bring an amused smile (if nothing worse) to the face of the professional zoologist.

But now for the *real* experts in fasting. The Natural History Museum in Kensington (London, England) once had on exhibit, securely gummed to a metal tablet, an

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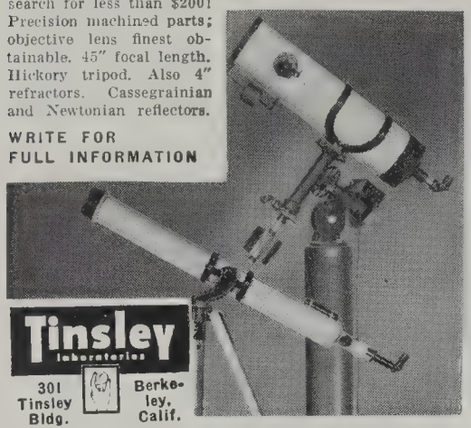

Egyptian desert snail. In its natural habitat, this snail is accustomed to lying dormant for long periods, waiting for the refreshing water that will revive it, perhaps after a long interval. Conditions in an arid museum must have been enough like the Egyptian desert to keep this particular snail in a state of prolonged dormancy. But one day, in the dim recesses of whatever serves an Egyptian desert snail for a brain, obscure processes began to work. The snail woke up after an interval of almost four years (from March 25, 1846, to March 15, 1850). One of the Museum officials, peering into the snail's case, noticed that the snail had formed a new membrane over the mouth of its shell. Scarcely believing his eyes, he carefully removed the snail and put it into tepid water. After fifteen minutes the snail was moving about, and the next day it ate some cabbage. All this happened many years ago, but I was pleased to learn, after I had mentioned this story in a broadcast, that a descendant of the man responsible for recording the incident in the scientific archives (W. Baird) wrote to the BBC confirming in general what I had said.

Another creature capable of being revived after a prolonged drought is the African lungfish. Lungfishes are also found in other countries, but it is the African species that I am concerned with here. About a yard long, and looking something like a conger eel with a flattened rear end, the lungfish lives in small streams and swamps which, under the African sun, sometimes dry up completely for months on end. That would be the end of the lungfish if it were made like an ordinary fish, but it has several anatomical peculiarities that enable it to survive prolonged drought and emerge again alive and well when the rains once more bring a watery paradise.

As the water begins to disappear, the lungfish estivates in a mud cake, in which there is a small hole connecting it to the surface and air. It breathes in and out about once every two hours. It provides its body with the small amount of sustenance necessary for its vital functions by absorbing its muscle tissue, sometimes reducing its total body weight by one half.

The lungfish preserves its body moisture because, during estivation, it is covered by a cellophane-like wrapping that is absolutely impervious to water and air and thus to evaporation. When the rains come, water runs down the air hole and enters the fish's mouth, which is the only part of its body not covered with the film. The moisture slowly awakens the fish, and by the time the rains have softened the surrounding mud, the lungfish is ready for action.

Under scientifically controlled conditions, lungfish have proved themselves able to live in their mud cakes for over four years and then be revived by moisture. Even after such a prolonged fast a lungfish will be swimming about and eating voraciously within a few hours.

Bed bugs and ticks are unlovely creatures, yet they cannot be disregarded when fasting is considered. A bed bug lives only on blood. Its beak is adapted for puncturing skin and sucking blood and for no other method of feeding. Meals may be at infrequent intervals; and for the species to continue, the bugs must be able to withstand starvation for a long time. I do not know the maximum period, but according to the publication *The Bed Bug* (His Majesty's Stationary Office, 1949) live bed bugs have been found in cubicles of a lodging house that had been vacant for three years.

In a letter to me, W. L. McAtee, formerly of the U. S. Fish and Wildlife Service, writes: "In the town where I grew up was an old soldiers' home, and it was reported that some of the inmates there had bed bugs which they had kept sealed up in bottles for various terms of years (five and ten, I recall), and I remember seeing at least one of these specimens which could still move but was practically translucent."

The habit of ticks is to wait on grass or other vegetation until a warm-blooded animal brushes past, and then to cling to it and gorge on its blood. But a tick may have to wait a long time before a suitable host comes conveniently near; and to survive such periods, the parasite must be remarkably resistant to starvation. It is. The Russian authorities on ticks, Pavlovskii and Skruinnik, have reported that one species *(Ornithodorus papillipes)* can live without food for seven and a half years. Even this may be well below the maximum for ticks, for as Ruth Crosby Noble points out in her book, *The Nature of the Beast,* J. Baron Uexküll and G. Kriszat claimed in 1934 that some ticks can live for eighteen years without eating!

Eighteen years without a meal—but it is still a long way from the maximum period that some creatures can exist without food or water. Long intervals of dormancy are possible only when the animal is thoroughly desiccated or when it has some provision for protecting itself from drying, as in the case of the lungfish with its "cellophane" wrapper or the snail with its diaphragm over the mouth of its shell. It is not so much a case of lasting without food as without water. The food requirements are reduced almost to nothing.

As far as my researches have gone, the record holders in food and water abstinence are some lowly creatures known as nematodes, a class of small worms, many of which are parasitic. It is possible that some animals even lower in the biological scale may be able

to resist starvation even longer, but I am not concerned with microscopic forms here.

It has been known for many years that nematodes can live for years without eating. They sometimes go into a state of dormancy, or suspended animation, but if moistened they frequently revive. In the eighteenth century some of these worms were observed to lie dormant for 27 years and were then revived. According to Prof. Heinrich Simroth, a nematode kept in galled wheat at the Zoological Institute of the University of Leipzig revived after 28 years of dormancy. It is probable that this nematode might have remained dormant even longer, but unfortunately an overeager laboratory assistant, presumably thinking that the preserving alcohol had evaporated, poured some into the specimen jar and promptly put an end to the experiment.

This 28-year dormancy and revival stood as the record until 1945. In June of that year, two United States Government experts on nematodes, G. Steiner and Florence E. Albin, were examining the leaf of a rye seedling. On it were several nematodes in a dormant state. When these were moistened, five of them, two females and three larvae, revived. Records showed that the rye leaf had been preserved since the autumn of 1906. As nematodes are unable to move around on or in dry material, it meant that these five lowly animals had existed without food and water for nearly 39 years.

Surely 39 years is the all-time fasting record—or is it? After the surprises I have had while collecting material on Nature's fasters, I am not going to claim even *that* as the record time that any animal can resist total starvation. Zoological truth is certainly more unbelievable than the nature-faker's fiction.

BORN ALIVE *Continued from page 419*

is the fastest tree traveler in the world. It mates in April, and the young are not born for almost twelve months. Whether the mother's suspicions are justifiable or not, she does not tolerate a male anywhere near her helpless babies. Within a few days after their birth, she leaves them for a night or two in April and mates again. After that she returns to her brood and nurses them through the summer as a good mother should, with the next batch already started in her womb.

Bears and bats have had their own problems and found their own solutions. Among the bats of northern countries, the embryos develop slowly in the fall and may actually stop development during the cold of the winter hibernation. While actual development requires only about three months, birth does not occur until the following May or June. At this time, the mother bats usually collect together. Each hangs by her feet and thumb hooks and spreads her leg membranes to catch the baby as it is born. During the day she hangs head-down, folding her blind, helpless sucklings to her breasts with her wings. At dusk she may fly out, taking her family with her. This can be a big load for a flying animal, for the babies may amount to more than a quarter of her own weight.

Bears generally find a den for the winter and spend much of the time asleep. They mate in early summer, and in the north the pregnant females go into a kind of twilight sleep. The cubs are born at the new year after seven or eight months' gestation. At this time, black bear cubs are blind and helpless and weigh less than half a pound. They know enough, however, to find the milk, and the mother sleeps on, possibly not even having awakened during her childbearing. Not for another 40 days do the cubs' eyes open and their teeth begin to cut, and it is spring before they can toddle out with the mother. Then for a year or more they go hunting with her, but during the second summer she takes a new mate and the youngsters acquire a stepfather. The reorganized family then travels together for about another year before the final breakup.

Birth itself is a somewhat arbitrary interruption of the course of growth, and the small size and seemingly premature birth of bear cubs is no disadvantage when compensated by the warmth, safety, maternal affection, and intelligence of the mother. This is even more strikingly shown among humans and other anthropoids, where family life has reduced infant mortality to the lowest rate for the animal kingdom.

A final contrast concerns not so much the manner and duration of life before birth, as the rate at which living material is produced. Human beings and the great whales are both mammals, with warm blood, live birth, and teats for suckling. Both carry their young for close to nine months. But one has the slowest and the other the greatest rate of growth yet known. At the end of nine months of development there is only a foot or so of human baby, and the next twenty years rarely brings a total of more than six feet. But the living substance is so organized that it may continue for a century, discover and split an atom, or create a symphony. The giant blue whale may be seventeen feet long at birth and fifty feet a half year later when it is weaned. In two or three more years it will have reached a length of seventy to eighty feet! But this blubber and brawn, shaped like a fish, lives little longer than a dog, and its fantastic rate of growth highlights the unique slowness in the forming of human protoplasm. Somewhere in the nature of this slowness lies the secret of our own humanity and the hope of our yet evolving.

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BOOKS

Continued from page 391

A NATURAL HISTORY OF TREES

- - - - - by Donald Culross Peattie

Houghton Mifflin Co., $5.00
606 pp., 163 drawings

PROBABLY no members of the living green world have such a wide popular appeal as do trees. Although man has found it necessary to cut down and clear out forests in order to live, one of his first thoughts after building his home, paradoxically enough, is to landscape it with trees. And should man wish to learn something about the trees that he has planted, something about their range or habit, uses or history—in brief, a bit of their natural history—he should make certain that this volume by Donald Culross Peattie is available in his home library.

Actually, this is the first in a series of several volumes which will discuss all the important species of trees (no hybrids included) of our continent north of Mexico. When complete, the set will be a sort of popular edition of the classical *Silva* of Sargent. This present volume encompasses northeastern North America (comprising approximately the region east of the 100th meridian and north of the 35th parallel), an area richer in trees than any other within the boundaries proposed to be covered in the set. For each species of tree Mr. Peattie has given us a happy blending of accurate scientific description combined with a fascinating essay on its natural history. Each of these essays is in the author's delightful style, which has earned him an enviable reputation as one of our best natural historians. To make this work even more widely useful—as a manual for identification—there has been added a general key to the species of trees based on characteristics of foliage. A fine glossary and indices to both scientific (the most recent terminology is used) and English names are also present. "Gilding the lily," as it were, are the beautiful and accurate wood engravings of Paul Landacre.

If the nature lover, whether amateur or professional, can afford but a single volume on the trees of northeastern North America, then this should be it!

W. H. HODGE

THE BIRDS OF ROCKY MOUNTAIN NATIONAL PARK

- - - - - - by Fred Mallery Packard

Rocky Mountain Nature Assn., 75¢
81 pp., 17 figs., 1 map

A FEW years ago (1945, *Auk*, vol. 62, pp. 371-394), Mr. Packard published a list of the birds recorded from this region that lies in the mountains of northern Colorado. The present booklet expands and brings the list up to date, placing it in a format suitable for pocket use by visitors to the park. Not only are new records added to the list, but brief diagnostic characters of each species or subspecies are given as hints for their identification. There is a sketch map of the park region and a number of fine line cuts of a few of the birds by Roger Tory Peterson.

Mr. Packard has used care in the preparation of the list. All authentic records of past years have been consulted, together with his own observations. No sight records are accepted unless supported by a specimen taken in the park region or in the Denver or Boulder regions and unless the circumstances of observation and the competence of the observer are satisfactory. Some immediately adjaeent terrain is included in the area of the list, just outside the official boundaries of the park. The notes on local distribution, as in the article in the *Auk*, give the inclusive dates of regular occurrence or, in the case of rarities, the actual dates of record.

The booklet should prove very useful for visitors to the park, who are invited to report any additions or unusual observations to the Rangers without delay, so that supporting evidence may be obtained while the bird is still in the neighborhood. With this co-operation, the list may be expanded in the future.

JOHN T. ZIMMER

LETTERS

Continued from page 386

courses than are the other owls of the United States. It frequently feeds upon crawfish and frogs and, if an opportunity presents itself, upon fish. One naturalist found that young Barred Owls quickly learned to catch and eat live fish placed in a dish of water in their cage.

Ewing Galloway photo

"In Africa and southern Asia there are true fishing owls. They have unfeathered legs; the claws are very sharp and have cutting edges; and the soles of the feet are covered with prickly outgrowths to aid in holding the slippery prey. These adaptations for catching fish are very much like those of the Fish Hawk or Osprey. Pel's Fishing Owl, which lives along the Congo River and elsewhere in Africa, is the finest and most powerful member of this group. According to Dr. James P. Chapin, the African natives consider this such a noble bird that only chiefs or their immediate relatives are permitted to wear its plumes as ornaments."

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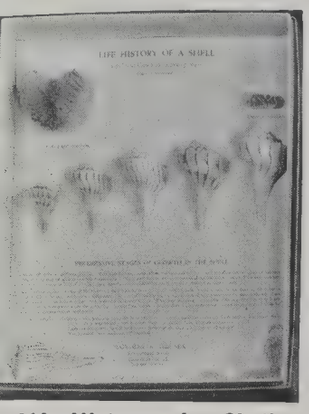

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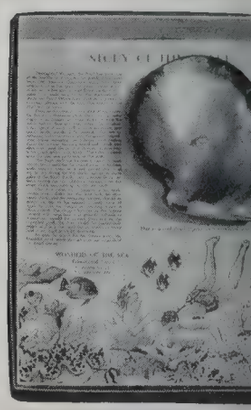

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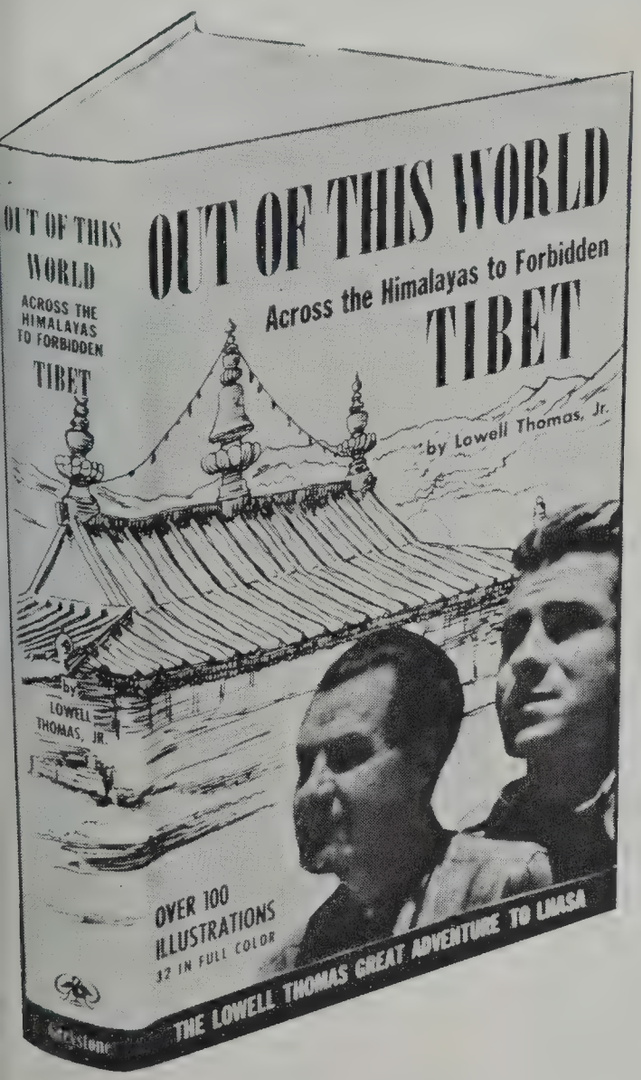
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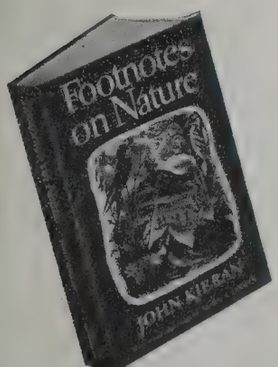

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LETTERS

Was there an Asiatic "Mayflower"?

SIRS:

Your article in the October issue of NATURAL HISTORY asking "Is American Indian Culture Asiatic?" is very interesting and quite convincing. Has anyone searched the early writings of Asiatic countries looking for records of an expedition, or expeditions, that might have carried the Asiatic culture to the Americas? If the cultures of Middle and South America, including the writing and methods of making books, was introduced from Asia, the introduction must have taken place after writing and bookmaking was developed on that continent. Consequently, a record might have been made of any expedition large enough to cross the Pacific in numbers sufficient to influence the culture of the Americas . . .

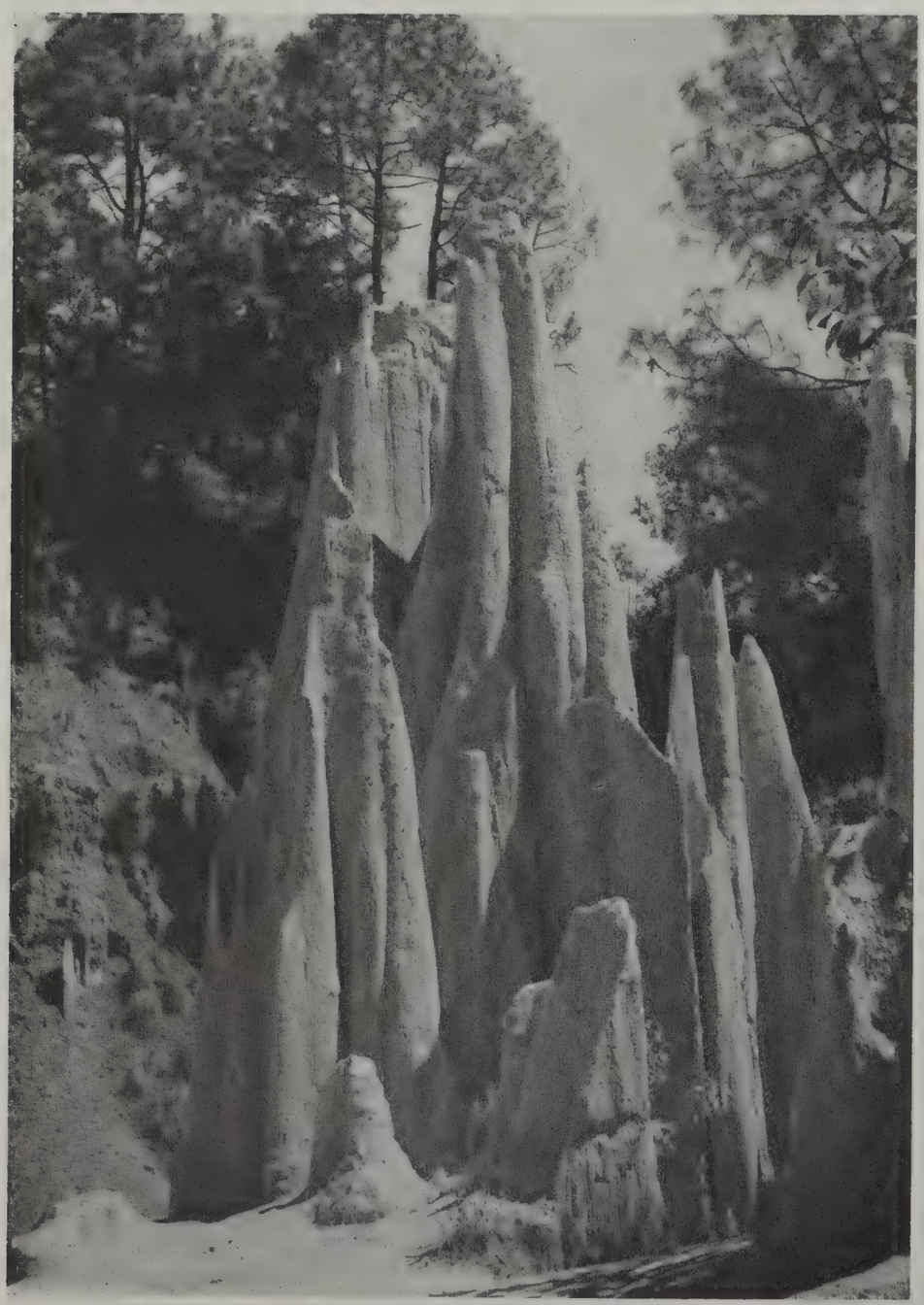
C. H. TURNER

Ozarks Chapter,
Missouri Archaelogical Society,
Springfield, Mo.

The following information is offered by Dr. Gordon F. Ekholm the author of the article referred to:

Yes, it might be worth while to search for the earliest documentary accounts of travel across the Pacific to the Americas. This would have to be done by scholars having a knowledge of the eastern Asiatic languages and of the literary sources where any such information would be found.

In Chinese annals of A.D. 499, there is an account of Fusang, an island reputed to exist in the Pacific and visited in that year by a Buddhist monk. Fusang is thought by some to have been the American continent. Other scholars believe Fusang to have been the island of Japan. The possibility that Fusang was some portion of the American continent has been proposed in a book by Edward P. Vining, *An Inglorious Columbus* (1885) and by Charles G. Leland in *Fusang, or the Discovery of America by Chinese Buddhist Priests in the 5th Century* (1875). Stefansson devotes a short chapter to this question in his *Great Adventures and Explorations* (the Dial Press, 1947).



No Termites Here

SIRS:

The accompanying photograph was taken several years ago in Guatemala, high in the mountains near Momostenango. It is not, as some may be inclined to assume, a termite nest, we are assured on good authority. It does resemble the termite nest of *Macrotermes* in Africa and the Orient. But these termites are confined to the Old World, and the details are different.

This is simply an illustration of the sculpturing power of time and weather. The soft rock has been worn down, leaving this peculiar formation, which reaches approximately 30 feet into the air. Outside of this one spot, I found nothing similar in all the surrounding territory, although there may well have been other examples.

It was said that the natives attached some special superstitious significance to this peculiarity, and that they frequently placed flat stones atop the peaks to prevent them from wearing away.

The stone is a golden yellow color and is quite beautiful against the deep blue and green of the sky and forest.

CECILIA M. EGAN

Staten Island, N. Y.

Unfertilized Eggs

SIRS:

Do birds in the wild lay unfertilized eggs as do chickens, or do they have some special instinct that causes them to lay only fertile eggs after their nesting preparations are completed? This question came up during a discussion of domestic animals, and we would appreciate any information you can offer.

Bronx, N. Y. GARY BRAUNER

The following information is offered by Dr. Lester R. Aronson of the Amer-

Continued on page 476

NATURAL HISTORY

The Magazine of the American Museum of Natural History

F. Trubee Davison, President | Wayne M. Faunce, Vice-Director In charge of Publications | Albert E. Parr, Director

VOLUME LIX—No. 10 **DECEMBER, 1950**

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You will find Natural History *Magazine indexed in* Readers' Guide to Periodical Literature *in your library*

THE COVER THIS MONTH

This is the red torch ginger (*Phaeomeria magnifica*)—one of the spectacular flowers that will delight the visitor to the Hawaiian Islands. It is one of the many plants of the ginger family that are found from tropical Asia throughout the warm Pacific islands. This particular species comes originally from the Sunda Islands in the Netherlands East Indies.

This is a large plant, whose leaf stems arch gracefully to a height of ten to twenty feet, with the long pointed leaves alternating in two rows up the stem. The impressive flower head you see in this color photograph is supported on a stem that may reach a height of five feet or more, separate from the leaf stalk. As can be seen in the photograph, the flower head is made up of numerous red, white-margined bracts. The basal bracts are large, waxy, and flowerless, and they form a nest for a cone-shaped head covered with smaller overlapping bracts. These are arranged spirally and are accompanied by small flowers. The cone-shaped head is about five inches long.

This picture was taken in Hilo, Hawaii, where the ginger was being used to provide a very ornamental hedgerow.

Tad Nichols

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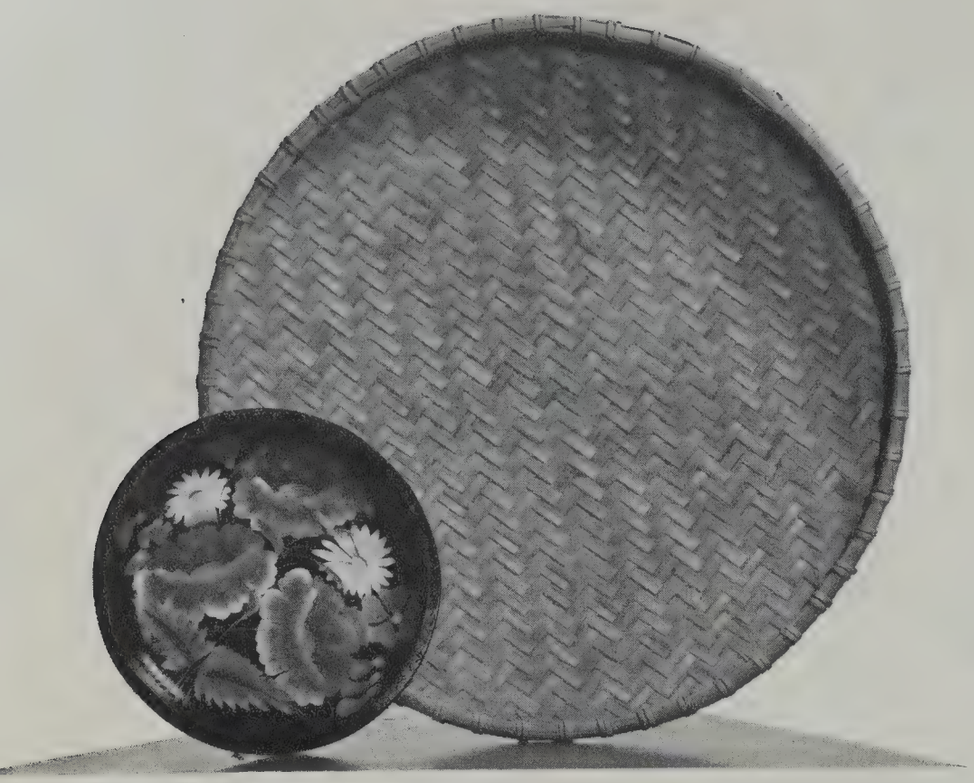

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YOUR NEW BOOKS

Kon Tiki • Menaboni's Birds
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KON TIKI

- - - - - - - - - by Thor Heyerdahl

Rand McNally and Co., $4.00
297 pp., 80 photos

READERS of NATURAL HISTORY will remember Heyerdahl's raft story,* his account of a remarkable voyage from the coast of Peru to the Marquesas Islands. The present volume, describing the trip in more detail, is so exciting and well written that it may become a classic of adventure at sea. It is excellent in so many ways that most readers and reviewers are completely unaware of the misleading and erroneous statements in the text.

Mr. Heyerdahl, convinced that the Polynesian Islands were settled from the American mainland, made the voyage to prove that it could be done. He gives the impression that there is abundant evidence in favor of his premise and that American anthropologists are too dogmatic to give him a hearing. Unfortunately, he is uninformed and misinformed on many aspects of the problem. For example, he states that the coconut palm was found in great numbers along the coast of Peru when the Spaniards arrived. Actually, Peru is outside the normal habitat of this palm. Moreover, in a land so dry that such perishable things as bean pods will survive 5000 years, not a single coconut husk, shell, or artifact made from them has ever been found.

There is evidence that people probably traveled from Peru to Polynesia in pre-Columbian times. More than 25 years ago it was shown that the sweet potato, a plant originally confined to America, had been taken to Polynesia and that the names applied to it there were of American origin. But to insist that this proves an American Indian origin for the Polynesians is somewhat comparable to claiming that they were responsible also for the populating of Ireland, because of the presence there of another American plant, *Solanum*, commonly known by a corrupted American name "potato."

There is further evidence, apparently unknown to Heyerdahl, that the Peruvians knew in considerable detail of the existence and of the position of Easter Island. It was their stories that prompted a Spanish expedition which sailed from the same port as the "Kon Tiki" 380 years previously, and, although its men did not follow instructions and missed Easter Island, they did discover the Solomons. We know, then, that there was contact between South America and Polynesia. Heyerdahl has indicated some similarities between Peruvian and Polynesian customs and legends, and we learn now that a Peruvian balsa raft can be sailed from Peru to Polynesia. But this does not add up to a conclusion that the peopling of Polynesia resulted from migrations from South America. There is more and better evidence that, basically, the peopling of the Oceanic islands resulted from movements outward from Asia.

Kon Tiki is a splendid adventure story, well worth reading. One should beware, however, of being charmed into accepting the misstatements, half truths, and poorly reasoned anthropological speculations with which it is loaded.

GORDON F. EKHOLM
JUNIUS B. BIRD

*June, 1948.

PRINCIPLES OF GENETICS

by Edmund W. Sinnott, L. C. Dunn, and Th. Dobzhansky

McGraw-Hill Book Company, $5.00
505 pages

THE "Sinnott and Dunn," first published in 1925, was for many years America's leading textbook of genetics. It dealt primarily with the essential Mendelian principles, and past editions had not quite kept up with the rapid advances in the field. The new edition of the *Principles of Genetics*, which introduces Dobzhansky as a third co-author, is thoroughly modernized. Among the many new features are three chapters on population genetics (populations, races, and species) and an up-to-date treatment of cytogenetics. Although even the latest research on bacterial genetics, biochemical genetics, and cytoplasmic genetics is dealt with, the volume has retained its character as a textbook of elementary genetics, an introduction to the field for the beginner. Over 200 illustrations help the interpretation visually. Examples from human genetics are used much more extensively than in earlier editions. The appendix contains a translation of Mendel's classical paper which laid the foundation to the whole field of genetics.

The "Sinnott-Dunn-Dobzhansky" can be warmly recommended not only to the student of genetics but to all biologists who want to bring their knowledge of the field up to date. This includes all of us, since there is hardly a branch of natural history in which a thorough understanding of genetics is not an essential prerequisite.

E. MAYR

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FISHES OF THE WESTERN NORTH ATLANTIC, VOLUME I

- - - Editor-in-Chief, John TeeVan. Authors, Henry B. Bigelow, William C. Schroeder, and Isobel Pérez Farfante,

Sears Foundation for Marine Research, $10.00,
576 pp., 106 illusts.

THIS impressive volume treats exhaustively of 70 species, 6 lancelots, 1 hagfish, 1 cyclostome, and 62 sharks. It really is a series of monographs dealing with all the species of these groups which inhabit the brackish and salt waters of the western north Atlantic, from Hudson Bay south to the Amazon. Its only competing predecessor, Jordan and Evermann's *Fishes of North and Middle America* appeared five decades ago and has long been out of date.

In breadth and thoroughness of treatment, in careful and detailed documentation, and in exhaustive record of pertinent published facts, the present series should remain unrivaled for another half century. The general plan is best illustrated by paragraph headings relating to individual species: Study Material, Distinctive Characters, Size, De-

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scription, Color and Color Changes, Development, Habits, Abundance, Relation to Man, Range, Synonomy, and References. The latter, as well as numerous footnotes, are generously annotated.

The most significant focus in the overall picture is the emphasis on Habits, which offers a welcome summary and a firm foundation for future intensive studies, when new methods have been evolved for direct undersea observation.

The sequence of treatments affords excellent opportunities for interspecific comparisons. For example, the realization that in extremes of size among sharks a whale shark may reach a length of 60 feet or more, whereas the female Cuban triakis measures only a foot in length and yet may contain two four-inch embryos.

It seems to me that the authors have been very successful in producing a work which, in their own words, "should be useful to those in many walks of life —to those casually or vitally interested in the general phenomena of life in our waters, to the sportsman whose interests are closely associated with pleasure and relaxation, to the fisherman whose livelihood depends on the knowledge of where fish are gathered together, as well as to the amateur ichthyologist and the professional scientist."

The second part in this series is promised before many months and will deal with the rays and skates, chimeroids, and sturgeons.

WILLIAM BEEBE

BRITISH WADERS AND THEIR HAUNTS

- - - - - - - - - by S. Bayliss Smith

The British Book Centre, $5.25
163 pp., 84 illusts.

MR. SMITH is an enthusiastic bird photographer and a successful one, judging by the illustrations in this book, two-thirds of which are his own. The remaining photographs are by various other individuals who were successful in getting pictures of certain species that Mr. Smith to date had failed to capture with his lens. In addition to the photographs, there are three plates of excellent drawings of waders in flight, the work of Basil Lakes.

The text is predominantly narrative in form and contains much of the author's personal observation and experience in obtaining the portraits of his favorite birds. Several introductory chapters, in particular, deal with days (and nights) in the field and with the problems of bird photography. The succeeding chapters discuss the various waders in turn, giving something about their characteristic traits and their local occurrence if at all unusual. Lastly, there is a series of half-page descriptive sketches of each of the species concerned, giving the salient details of measurement, plumages, call notes, display, food, distribution, and the like. Each of these items is preceded by a key number, used for each of the species, making it easy to compare them with each other in respect to any of these factors.

The running account is very pleasantly written and devoid of technicalities, and it can be recommended to anyone who likes to read about the ways of birds and bird photographers or who enjoys interesting photographs of wildlife.

JOHN T. ZIMMER

TIME AND ITS MYSTERIES, Series III

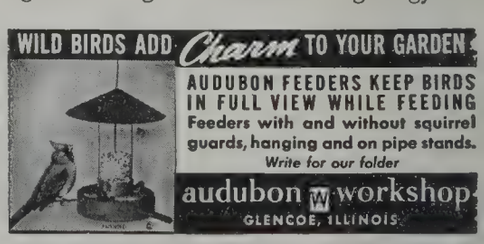
by Henry Russell, Adolph Knopf, James T. Shotwell, George P. Luckey

New York University Press, $3.00
126 pp.

THIS book presents in published form the III series of lectures on "Time and Its Mysteries," given under the auspices of the James Arthur Foundation of New York University. The four contributions that comprise the book have been written by men of outstanding achievement and reputation in the fields of astronomy, geology, history, and watch making. The four essays are, needless to say, authoritative, yet they are written with such clarity of style as to make them readily understandable and interesting to the general reader.

Professor Russell discusses the problem of a time scale for the universe, describing four independent lines of evidence for such a time scale. These are: radioactivity, the time scale of galactic motions, the time scale for binary stars and clusters, and the life cycle of a star. From these lines of evidence he shows that the universe is going through a long history of transition—a history that extends billions of years into the past, and probably will extend billions of years into the future.

Professor Knopf is concerned with the age of the earth. He presents a clear and timely discussion of modern methods of dating the earth's age, especially by the study of radioactive elements. Nor does he neglect to consider, for supplementary evidence, such problems as erosion and the deposition of great river deltas, stratified or varved sediments, and the salinity of the oceans. From this discussion he shows that the earth must be something more than 2000 million years old, and he indicates how recent work on radioactivity has aided in the establishment of an absolute time scale for geologic history. The greatest single contribution of geology to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modern thought, says Professor Knopf, is "the realization of the immense length of time."

Professor Shotwell's contribution is entitled "Time and Historical Perspective." He shows how the need for time gradually developed among primitive peoples. Then he goes on to trace the establishment of calendars by the early Egyptians and Babylonians, and from there he carries the story on to Greek and Roman history. Finally, he traces the historical perspective of time through the Middle Ages and on to our own day.

The final part of the book, by Mr. Luckey of the Hamilton Watch Company, is an interesting account of developments in portable timepieces.

This book, a worthy successor to the preceding volumes of the series, should be a valuable addition to the library of anyone interested in the subject of time. Each of the four papers that constitute the volume makes a half an hour or so of excellent reading. Moreover, this book is a useful reference volume to have within easy reach. Finally, it is beautifully printed, which makes it a nice book physically.

EDWIN H. COLBERT

THE PHASIAN BIRD
- - - - - - - by Henry Williamson

Little, Brown and Co., $4.00,
276 pp., 24 wood cuts

THIS is ostensibly the story of a hybrid pheasant in Norfolk, England, but the main theme is rather the rejuvenation of the run-down farm on which the bird lived. A great deal of space is devoted to agricultural practices and the activities of the people in the neighborhood, with less attention to the wildlife, including the avian hero, "Chee-kai." The bird thus occupies somewhat the rôle of a feathered Moby Dick—as much a symbol as an active character.

It is difficult, therefore, to consider the tale as a piece of true nature writing or bird biography, and perhaps this was not the author's intention. There are, in fact, a number of things that are highly dubious. Such are the incident of the goldcrest dropping to the back of a migrating owl and falling asleep during the remainder of its journey; the pheasant attracted to the scent of planted artichokes or turning its own scent inward; a ringdove so stuffed with acorns that it could not fly! It is rather for its literary flavor than for its natural history that the book should be appraised. Regrettably, many sentences are too long and involved to be altogether pleasing, while the casually introduced words of the author's invention, not to mention the Norfolk vernacular, almost call for a glossary. There are, however, many fine word pictures that give a glimpse of countryside with which the author is unquestionably familiar.

JOHN T. ZIMMER

HANDBOOK OF ATTRACTING BIRDS
- - - - by Thomas P. McElroy, Jr.
Illustrated by Lambert Guenther

Alfred A. Knopf, $2.75
163 pp., 51 illusts.

THIS highly practical guide to attracting birds is crammed with information from cover to cover. Mr. McElroy, who is Curator of the Pequot-sepos Wildlife Sanctuary in Mystic, Connecticut, has obviously gathered information both from experience and from other publications. Of the latter, the first to come to mind is *The Audubon Guide to Attracting Birds*, now out of print. The present volume lacks the colored plates and photographs of that work, but it is more terse and has more explanatory sketches. There are specific plans for building bird houses, for selecting and planting shrubs and flowers useful to birds and pleasing to the eye, and for doing many other things designed to encourage birds.

Consideration is not limited to songbirds. One chapter is concerned with the problems of managing waterfowl, and another deals with upland game birds. There are also informative chapters on the role of predators in nature, on the care of young birds, and on bird identification. Finally, there is advice on founding a municipal wildlife sanctuary, complete even to the point of supplying tentative articles of incorporation. Although intended primarily for the eastern United States, most of the information in this handbook will be applicable elsewhere.

Anyone wishing to attract and encourage birds around his home will find many valuable suggestions in this book. Even those who have been interested in this subject for years will find new ideas to try out. My wife, for example, has decided to chisel a bird bath in the top of a small granite boulder in our rock garden—McElroy says it is easy!

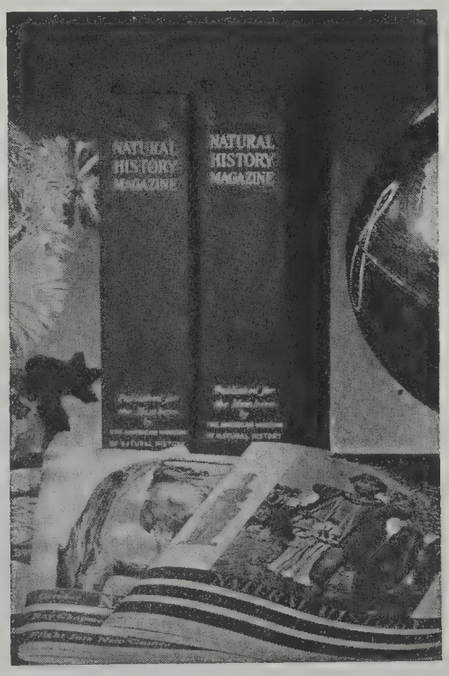
DEAN AMADON

MENABONI'S BIRDS
- - Illustrated by Athos Menaboni
Text by Sara Menaboni

Rinehart and Co., $10.00
132 pp., 8 x 12 inches; 109 illusts.

MOST authorities, if asked to list a few of the leading painters of birds in America today, would include the name of Athos Menaboni. His work rarely appears in books and journals, though it adorns the walls of many homes, especially in Menaboni's adopted city, Atlanta, Georgia. The present sumptuous volume will make the work of this artist available to a much wider circle. Thirty-one full-page paintings of birds have been reproduced in color, for the most part excellently, and 13 more in black and white.

Continued on page 476



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Has the Grand Canyon a Rival?

The thrilling story of how a band of scientists threaded their way for twelve days over trails known only to Tarahumare Indians to reach a gigantic canyon, reported to be deeper than the Grand Canyon of the Colorado

T

▲ A VIEW of the Barranca del Cobre from the rim. The canyon was reported to be 100 miles long, and it was so intricate in its sculpturing that the explorers sometimes found it difficult to know which was the main gorge

➤ THE EXPEDITION'S INDIAN HELPERS. *Left to right:* Pancho, Francisco, Isidro, Juan, and Chrispine, the cook

escent into the Barranca del Cobre

By ROBERT THOMAS MOORE*
Director, Zoological Laboratory, Occidental College, Los Angeles, California

All photographs by the author

Part I

FATHER Salvatierra went to the famous canyon of Hurich in 1684. "At sight of the precipice," the venerable father is quoted as saying, "such was my terror that I . . . did not precisely dismount, but let myself fall off on the side opposite the precipice, sweating and trembling all over with fright."[1]

This canyon, better known as the Barranca del Cobre, was first brought to my attention in 1933, while I was collecting zoological specimens on the Guirocoba Ranch of Jim McCarty in extreme southeastern Sonora. Jim said he had been told it was deeper than the Grand Canyon. No white man had visited it, he said, since the padre mentioned above. Curiosity prodded me to inquire about the possibilities of leading an expedition to determine its depth, to see the cliff dwellers who inhabited its caves, and, most important, to bring back a collection of birds and mammals. The area was unexplored zoologically and might contain forms new to science.

Jim tried to discourage me. He had traveled only four days toward the canyon and said it had been the most hellish journey he had taken in thirty years of mining trips! A Mayo-Tarahumare Indian he knew had told him it would take fifteen days to get there. Knowing Jim to be a rugged "desert rat," not wont to be daunted by ordinary difficulties, I asked for details.

"Wa'al," he replied, eying me coolly, "first, it's heat on the burnt-up southern foothills facing the Fuerte and the sun. We'd be in that cauldron for five days while we climb nearly 8000 feet. Furthermore, it's pig pools for water for four of those days! If that doesn't poison us, the fires the Indians set to plant their corn may block the only trail! Finally, the regular rainy season may come early before we can get back, and we can't go before May, because the Chinipas and El Fuerte may be running above their banks from melting snows in the high mountains. I've known a calf-like stream to rise 30 feet in one night from a cloudburst and put you in the trees, your bedding and food washed away!"

"Anything more?" I asked, trying to appear undaunted.

[1]Francisco Javier Allegre, *Historia de la Compañía de Jesús en Nueva España* (Mexico, 1842), Tomo III, pp. 48 and 51-52.

*ROBERT T. MOORE, one-time editor of an ornithological publication and a breeder of silver-black foxes, is a zoologist, lecturer, author, explorer, and mountain climber. He was the leader of two expeditions to southern Ecuador, during which he succeeded in ascending Mt. Sangay for the first and only time in history. He has also led eight expeditions to Mexico. On these field trips he discovered many birds and animals new to science. His vast collections of over 60,000 specimens include the world's largest assemblage of the birds of Mexico. He is the Director of the Zoological Laboratory at Occidental College, Los Angeles, and has recently presented his collections to this college. For four years he was Chairman of the Galapagos Committee and was instrumental in having a large part of this Archipelago set aside as a sanctuary for zoological life. Dr. Moore is the author of over 70 articles on zoology, breeding, and exploration and is Chairman of the group of co-authors of The First Check List of the Birds of Mexico.—ED.

▲ WOOD'S PARROT (*Amazona finschi woodi* Moore) from a painting by Walter A. Weber. The scene shows Arroyo Hondo, where the bird was discovered by the expedition

"Yes. I don't like the way Juan says he 'knows' the trail. I'll bet a dollar to a doughnut he's never seen the Barranca and he's dependin' on some sweetheart up in the Tara country to show him the way. As for the others, they may desert anytime."

"Then you're afraid to try it?" I challenged.

"Oh, no, Bob," he exclaimed with calm fire in his gray eyes. "I'll go, but you're warned!"

So here we were, a year later, chugging up to Jim's ranch door at eight in the evening, after crossing the plains from Navajoa and its glittering flame trees on as hot a day as a copper sun can create. Our party consisted of Jim, Paul Austin, Tommy Wright, our chief preparateur; Juan, five half-breed Indian *cargadores*, myself, fifteen burros, and five mules. It was on May 4 that our party clattered forth gaily on the "Caliente Trail," whose name should have warned us of the heat that was to come. The hoofbeats of our pack animals startled a large flock of Sonoran White-fronted Parrots from the feathery *sabinas* arching overhead, and they soared about in short half arcs, chattering continuously on the same note. We disregarded the heat, believing we soon would climb into a cooler region. Here, too, we saw our last flock of Magpie Jays and marveled at the grace of their cadet-blue tails, eighteen inches long, streaming across a brassy sky. Equally striking were the great Military Macaws, always in pairs, propelling themselves with powerful strokes at high altitude, while they talked to each other with raucous familiarity.

That afternoon we passed Colmoa on the Rio Fuerte and plunged into the stifling Limon Canyon, its cliffs covered with columnar *hecho* cacti and the rambling obese roots of huge wild fig trees. That night we tented at Palmar, where chachalacas filled the night with a counterpoint of harsh calls.

The next morning we passed a wooden cross stuck in a pile of rocks marking the spot where someone had been assassinated. Had we been superstitious, we might have forecast disaster, but still beauty stayed with us, defying the increasing heat. An enormous grove of *amapas* waved a golden salute; a Coppery-tailed Trogon streamed across our trail, his flashing belly blood-red in the fiery sun; and great white salvers of what Jim called "papache" flowers hung in areas of radiating fragrance. That noon we lunched at a vile-smelling spring, whose filth had lured a group of pigs to wallow in it, and then our first enemy struck without warning. Paul, parched beyond endurance but heedless of our shouts of danger, fell prone and drank. Ironically, flaming cardinals were whistling and mockingbirds were singing as if to taunt our throats, which were too dry to sing or even talk. Descending a long exposed grade to the accompaniment of the cries of vulture-like hawks, the Caracaras, we hobbled into Descanso, Sinaloa, to find a spring of PURE water near a grove of *huamuchil* trees. Our swollen throats were soon lubricated. If only Paul had waited! That night he was seized with cramps and rolled in pain. I kneaded him throughout the

anxious hours, while a screech owl, the Sinaloa Vinaceous,[2] quavered a tremulous obbligato. Dogs howled, mosquitoes bit, pigs snooped, and Indians stumbled about, drunk from the *Cinco de Mayo* celebration.

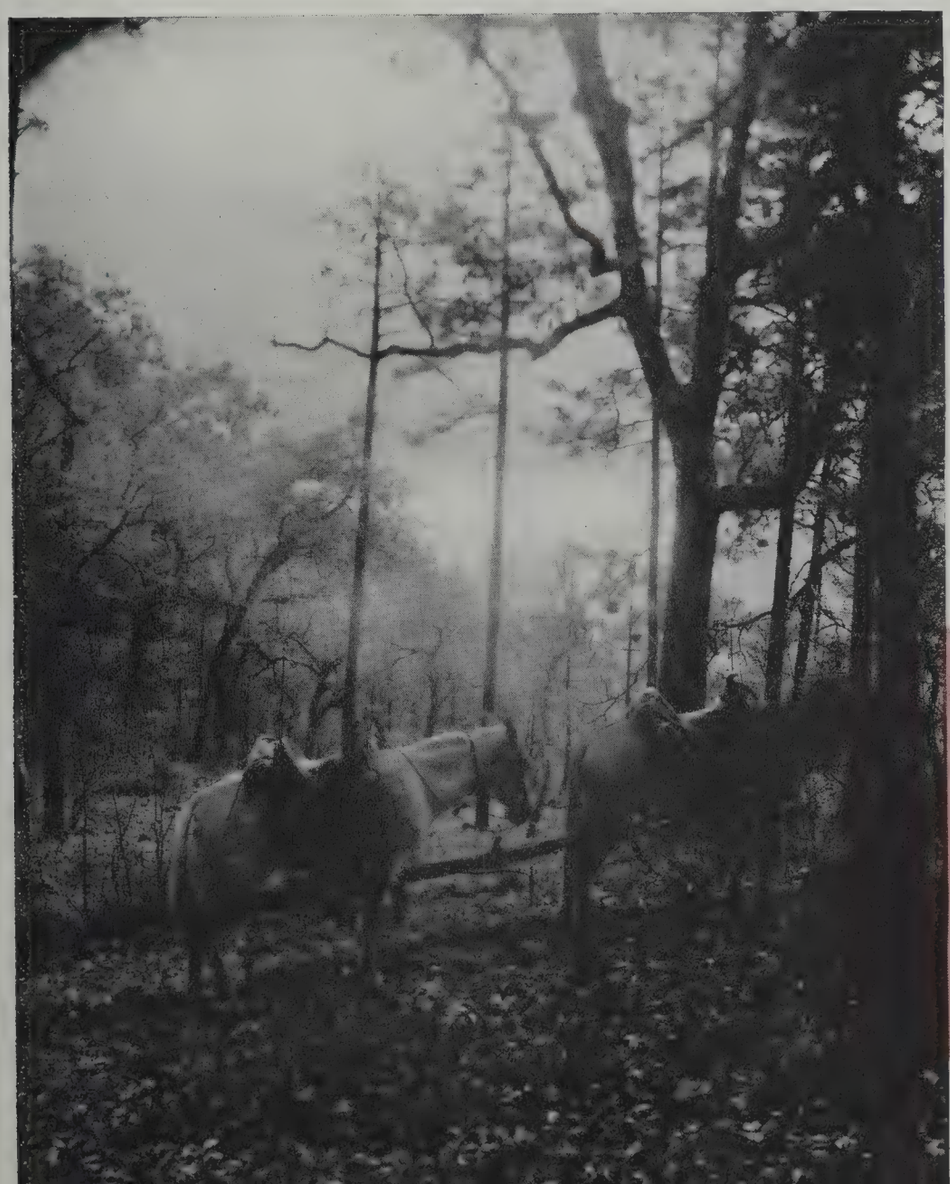
In the morning Paul, though obviously weak, insisted on continuing. Jim refused to vote, saying we would reach an altitude of 1600 feet at El Orito. When I asked him if it would be cooler, he shook his head. I made the difficult decision to go forward for at least one day more.

About ten in the morning we reached La Junta, the junction of the Chinipas and El Fuerte. Pushing our way through white flowering papaches as fragrant as gardenias, we entered the swirling Chinipas above the junction. The water rose to the backs of the wobbling mules, but we got through without disaster. Sheer cliffs faced us, but we reached El Orito at 1600 feet. The altitude proved no cooler, and we crawled under a low oak to lunch.

Now it was Tommy's turn to collapse. Refusing the canned crabs, which still tasted good to Jim and me, he plunged into the dirt under a desert shrub and paid no heed to questions of concern. His old enemy malaria had struck him down. I had not known he was subject to periodic recurrences. Two hours later he insisted on continuing, so we lifted him onto the most comfortable mule we had. For the next two days he hunched in the saddle like one in a trance. Philosophy was now our only comfort. Jim and I passed it back and forth in a desperate attempt to keep up courage. Crabs still tasted good to us, but sardines were anathema to all.

On the 7th, after leaving the oaks at 1800 feet altitude, a steep, torrid climb brought us to 2300 feet in an association of mountain mahogany, papaches, and white lantana. Our throats were now parched and swollen almost beyond endurance. During the lunch hour at Cresta del Cedros, Jim looked mournfully at a slimy pool of green water at the base of a cliff, forbade us to drink it, but suddenly succumbed himself. His years of prospecting must have made him immune, for he suffered no ill effects. But the situation was getting serious. I reached into my personal bag and took out one of the cans of grapefruit juice I had reserved for this purpose. No nectar of the gods could have tasted more delectable. My other ones must be kept for the hot days ahead and the return trip through this inferno. Paul and Tom were now in a bad

[2] *Otus asio sinaloensis*. After the expedition's return to the States, it was described by the author as new to science (Proceedings of the Biological Society of Washington, vol. 50, p. 64).



▲ A NATIVE FAMILY of Tarahumares in the Vasagota Valley

◀ FROM THE CREST of the Sierra Madre Occidental at 7400 feet, the explorers looked down into the cuplike Vasagota Valley, completely rimmed by mountains

way, and the heat had shaken the endurance of all. Tough old Jim maintained his cheerful attitude and sphinxlike smile. My notes that night were anything but cheerful: "Tom ill, Paul still in a bad way. We met Indians who say there are huge fires ahead! Mosquitoes and wandering burros, frightened by jaguars, make the night hellish!"

On the morning of the eighth, Jim called me aside and admitted he was worried about the condition of the mules. He feared they could not make the 3000-foot climb up the Cresta del Tigre in the terrific heat. Further, he said that the Indians we had met had reported that the fires, set by bee-hunting Indians, had burned up the grasslands beyond the Tigre, where he had hoped the pack animals could recuperate their strength. We must buy corn as soon as possible. We decided to risk the Tigre and hope to get corn from Indians at villages above it.

El Tigre proved true to its name. Its claws were sharp rocks on the slopes of hairpin turns, which ripped our bags and unseated the loads. Halts became more frequent for adjustments, and all the pack animals were breathing heavily in the murky heat. Sweat rolled down our bodies. We were stripped to shorts. We made the top at the 4000-foot altitude and found Encino Gordo nothing but a huge fallen oak by the road and one hut on the mountainside. The occupant would not sell his corn! Our duffel bags were cut in several places and had to be repaired. They would not stand much more.

That night jaguars frightened the pack animals. As I planned for the morrow, I watched the burros hovering close to our sleeping bags, their patient faces bespeaking ages of endurance of hardships, amid cruel sunlight and dangerous darkness. Little sleep for the leader! But the predawn brought one of the loveliest songs I had ever heard, rivaling the Fox Sparrow's of the Magdalen Islands in the Gulf of St. Lawrence. It began with three rapid high-pitched notes on the same tone, followed by a dashing series, zigzagging up and down the scale, and ending with an exquisite trill of rich overtones. I guessed it to belong to McLeod's Sparrow, which I had never heard.

On this morning of the ninth, an Indian boy rushed up with news that the fires had crossed our trail ahead, burning several square miles and consuming the grass we were relying upon. At eleven o'clock we rounded a cliff and came in sight of the flames. It was a frightening prospect! The fire had cut our only possible trail, and a wind was driving the flames toward the great Cumbre de Lojito, which Juan claimed was a worse ascent than El Tigre.

Skirting the fire, we left the trail and drove our tired animals up steep rocky ridges. At last we dropped into a ravine and gulped down a hasty lunch under our first cottonwoods. Jim wanted to make

◂ ARROYO HONDO, viewed from beneath the cliff where the Stygian Owl awoke the author

camp here for the night to rest the pack animals, as they would have no food above. I protested vigorously, pointing out that should the wind veer in our direction, we might be completely trapped by the flames. Fortunately Jim yielded, and we climbed a half mile higher up the ridges to a small field and hut, known as "Portreros." While we watched, the wind did change and the fire swept that ravine. Jim, Tom, and two Indians who had crept down to bathe in the pools barely escaped being asphyxiated. Our pack animals were exhausted, but they were munching the little grass available, and I reluctantly gave orders to camp.

We watched the wind drive the flames up the front of our mountain eyrie, while a thunderstorm without a drop of rain passed over our heads. Slowly the fire mounted the rocky slope. Less than an eighth of a mile away, the wind died down and the flames, having little but rocks to feed on, sputtered out. But the fire continued to burn below. By changing sentinels every hour, we tried to snatch a few moments of sleep before dawn.

On the tenth the Cumbre de Lojito proved to be everything the Indians claimed, a frightful climb of 3500 feet. Exceedingly tortuous and steep, it displayed an endless number of hairpin curves and a trail that was nothing but a bed of rocks. For a while it seemed the mules could not possibly make it, although the burros managed better. Every 200 or 300 yards the loads slipped and had to be rearranged. All the animals breathed heavily, frequently stopping and refusing to climb higher. The Indians were nimble as jack rabbits whenever a burro jumped the trail to try to turn and descend.

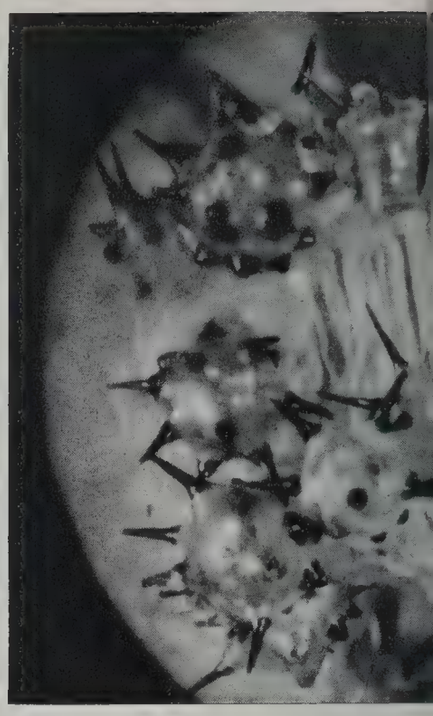
At a point nearly 6000 feet in altitude we paused and were amazed at the tremendous panorama of the entire route we had covered during the past seven days. All of southern Sonora lay at our feet, and Jim pointed out two peaks that he said were near his Guirocoba Ranch. We were among pines and oaks in the Transition Zone. We had much to be thankful for. It was cooler now, and for the first time in three days Paul and Tommy seemed more lively. Zestfully we threw ourselves prone beside mountain streams of pure water that dashed across the trail. Flower and bird life had almost completely changed; the beautiful red-barked madroño had become common.

Two hours later we reached the top of the climb at 7400 feet. Behind us curled the snaky trail of our ascent; on the other side, 1000 feet below, lay a cuplike valley completely surrounded by a mountain rim. Down the two-mile floor cascaded a wild torrent through a patch of farmland which was being worked in community by a group of Tarahumares who called their valley Vasagota. But the greatest surprise was acres of wild grass for our starved mules and burros! We immediately decided to camp for two nights to give the animals and *cargadores* a well-deserved rest. Meanwhile we would collect zoological specimens. Our first attempt was a combined hunt for a giant bat coursing at great speed over our tents. At length Tom dropped it, crying, "I've never seen anything like it!" But the most interesting sounds to me were unmistakable gobbling on the mountain walls. During the night I heard these turkeys from four different points on the rim. Hunters had reported them to be extremely large and black, but no specimen had reached the museums.

On the eleventh, Paul and I hunted turkeys from the predawn until darkness, when a rain-bombing thunderstorm forced us to find our way back through an inky night to the tents. I saw none, but Tom had encountered five without securing one. I collected several specimens of the Chihuahua Grosbeak, however, of which only one individual had ever been taken before. Hummingbirds and warblers of several species were common, and I observed two Thick-billed Parrots at close range, apparently the first record of their occurrence on the western side of the Sierra Madre.

Continued on page 473

➤ JIM MCCARTY and the turkey new to science that the author secured at Guayachi

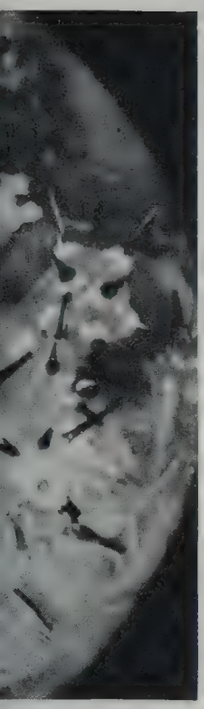


The camera brings us closer than we ordinarily get to one of the wonderful transformations in the insect world

By
LYNWOOD M. CHACE

▲ THIS CLOSE-UP shows how the oddly fashioned legs of the Cecropia caterpillar grasp onto a twig. The creature can cling to a branch so tightly that it is sometimes difficult to pry it loose

A Cecropia Moth Emerges



➤ EVERY SO OFTEN the caterpillar of the Cecropia moth sheds its skin. Here is the discarded skin in a wrinkled condition

➤ WHEN THE CATERPILLAR reaches a certain stage, it begins to spin a cocoon for itself, producing the silk substance from its mouth. The caterpillar slowly waves its head back and forth, attaching the silk strands to objects to form the cocoon

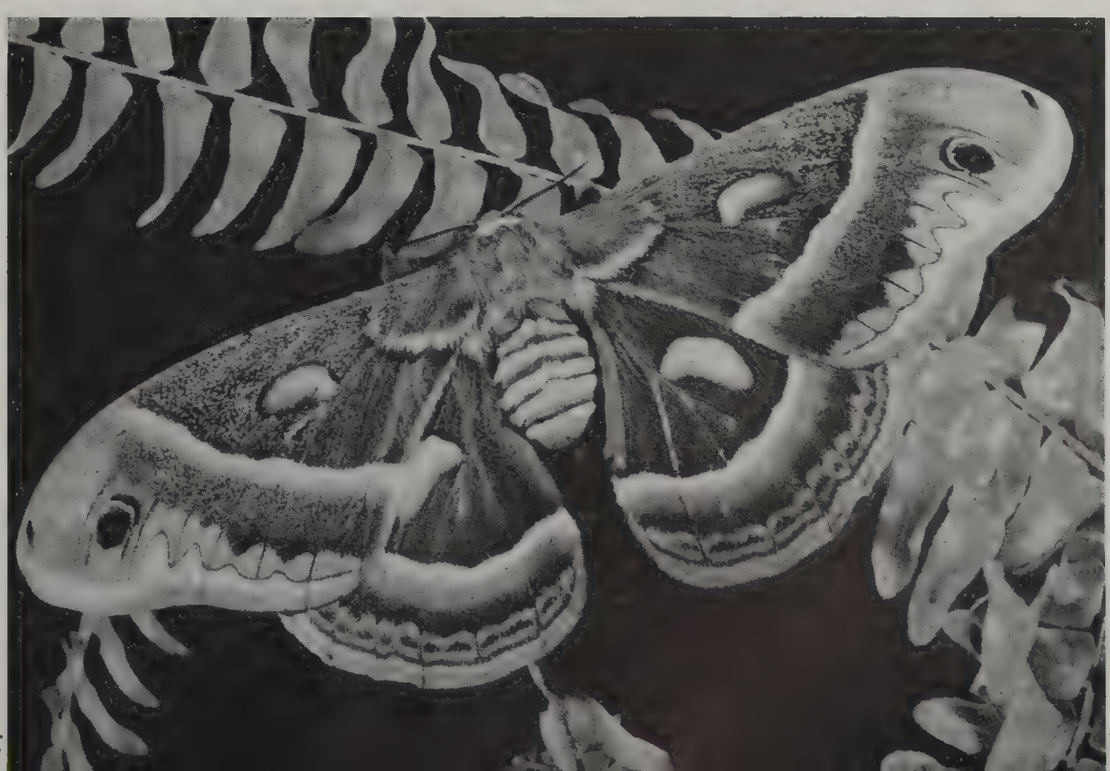
➤ HERE THE COCOON is almost completed. Its walls are still thin, and you can see the caterpillar within. The insect is now hard at work constructing the interior of the cocoon

➤ HAVING COMPLETED the cocoon, the Cecropia caterpillar sheds its caterpillar skin and goes into the pupa stage. Here the cocoon is cut open to expose the odd-shaped pupa. The cocoon is carefully constructed with an outer silk layer and an inner one of silk packing. Thus the pupa is protected from freezing in cold weather. The moth does not hatch until the following spring

◂ WHEN the weather gets warm the following spring, the moth emerges from the cocoon to renew the cycle enacted by its parents

▾ WHEN THE MOTH first crawls out of the cocoon, its wings are soft and very fragile. It clings to a twig until its wings are fully developed. This is a male Cecropia

IEWED AT close range, the like antennae of the male ropia and its shaggy "face" it a fantastic appearance. most of us see the insect a greater distance — as a dsomely patterned creature he air



➤ THE FEMALE moth, which emerged from a near-by cocoon, is likewise a beautiful creature. Its wings, now fully spread, display a lovely pattern

Acme photo

HOMEWARD BOUND: well loaded with sardines, the purse seiner leaves the fishing area and heads for port

your unknown friend THE SARDINE

Millions welcome him on the menu, but few can cope with him in the dinner table conversation

By LORUS J. *and* MARGERY J. MILNE

Philip Gendre

WE were on familiar terms with sardines laid neck to tail in olive oil, but it took a whale to introduce us to a live sardine. We knew the sardine in mustard, in chili sauce, and in just plain "oil"—all neatly packed in a can with a key, but the living fish, complete with head, insides, and particularly scales, in its home at sea—that was completely beyond our experience. So were whales, in spite of Frank T. Bullen and Herman Melville. But our introduction occurred on board a little fishing boat off the Maine coast near Ogunquit, on a course that led to lobster traps.

When a Maine fisherman, minding his own business, sees a whale surface and spout a few hundred yards from his boat, he doesn't shout, "Thar she blows!" He doesn't even yell. But he may remark drily, as one did to us: "Must be sardines yonder." For whales are a major peril to small fish, and sardines (before canning) live in schools that number upward from three billion individuals to populations of nobody knows how many.

The finback whale that made the introductions occasioned us so much excitement that we almost missed the skipper's casual comment. Sardines had no space in our minds while a live whale, our first, was humping its huge back into sight as though riding the curve of an enormous barrel rotating slowly below the surface. The blackish mound would rise into view, only a foot or two out of the water but as broad as our boat. The blowhole would open and a cloud of vapor push up 20 feet into the air like a miniature of Old Faithful. Then the smooth movement of the forward roll would take the head below while a tremendous back heaved over, its progress marked by a small triangular fin. But the back was as long as our 40-foot boat, and it slid from sight without a visible flip of the transverse tail behind it.

No doubt sardines by the million were rushing at top speed away from the whale. Our skipper pointed to the water just beyond our boat, and while no fish were visible, the whole surface was roiled by the movements of the swimming just below. Why they remained so close to the surface when a concerted dive might have eluded the whale, we could not guess. But the monster mammal plowed through the

frantic fish, and it was easy to reconstruct what happened each time the cavernous mouth opened and closed. As the gape appeared, water and fish rushed in, but when it closed again, only water emerged. The sardines were tangled among the hundreds of hair-fringed whalebone plates hanging like thin flexible stalactites from the roof of the animal's mouth. And when the lips met once more, a great bulbous tongue rose from the floor—partly by muscular action, partly by inflow of blood into tissue spaces within—and squeezed the sardines out of their nooks and crannies, down the whale's throat.

The herring gulls above were no more concerned about the whale than were the Maine fishermen. Far from the cetacean or close to it, they recognized the turbulent water stirred by the sardine schools. In plunged the birds, to rise with fish in their beaks, to swallow them while air-borne, then to dive again for other victims, until their crops were full. This was their method of catching herring—for the Atlantic sardine along the Maine coast is *Clupea harengus,* whether food for whale or bird or man.

Almost everything in and over the sea, as soon as it is bigger than a herring, begins to eat these fish. And since herring come in so many different sizes, perhaps no one kind of backboned creature is more preyed upon by its neighbors. The bluefish and the tuna, the whitefish and the cod, the dogfish and the haddock, hake, pollock, and squid, all devour countless numbers. Seals and porpoises fatten at the expense of herring. For man "the herring is beyond question the most important of food fishes in the Atlantic, if not in the world." Small wonder, then, that the life span of a herring cannot be stated in years. Of 30,000 eggs laid annually by each mature female herring, an average of less than 2 survive to repeat the cycle. On the precision of this average rests the rise and fall of sardine populations in the sea. And on the 29,998 or 29,999 that are lost each year from each pair of Atlantic herring, numberless creatures depend for their own survival.

To survive so many successful attacks by enemies, sardines themselves must find plentiful food. Each of them is equipped with a sort of sieve in the gill region, which effectively strains out food particles from the water. The particles are microscopic algae and other minute plants in the upper levels of the sea (where sun energy can penetrate), plus the hordes of barely visible crustacea and various animalculae. Collectively these are known as plankton, and the sardine is a plankton feeder. Of all the small creatures on which herring thrive, almost the only one to have a common name is a tiny crustacean belonging to the genus *Euphausia.* It is known to fishermen as "red seed," because it becomes so abundant as to color patches of the sea. Sardines take both the algal plankton on which these crustaceans feed and the crustaceans themselves. Finback whales are equipped to filter from the same water both the "red seed" and the sardines that prey upon them.

Since no animal is more than ten per cent efficient in its use of food, a ton of sardines represents at least ten tons of "red seed" or similar food. And the "red seed" require at least ten times their own weight in algal plankton—hence a ton of sardines in this simple food chain rests on a minimum of a hundred tons of microscopic plants. A ton of whale represents further inefficiency and demonstrates how incredibly abundant are the living green "pastures of the sea," which supply the needs of "red seed" and sardines and whales and keep ahead enough to reproduce themselves as well. Man tends to overlook the immense quantities involved, but herring keep browsing until death overtakes each fish. Not that the huge population is wiped out at any one age. Some reach a length of eighteen inches—as multiple grandparents of more little sardines. Such a giant herring may be twenty years old,

R. Gates photo from Frederic Lewis

NETS filled with the sardine catch are emptied into a small boat, which will transfer them to the fishing fleet. In New Brunswick waters

while those a gull or man prefers—five inches or less in length—have not yet reached their first birthday. Most of each 30,000 never live that long. But a ten-inch herring has reached reproductive age and is usually about three years old.

The eggs of the Atlantic herring are heavy; they stick together and sink to the bottom. The most valuable sardines of international trade, however, start out in no such fashion. They are the French sardines—luxury tidbits that gave the common name to the whole group of little fish, because Sardinia, in Mediterranean waters, was where this delicacy abounded. And a French sardine comes from a buoyant, floating egg—one of 60,000 each mature female lays through the summer. Properly these fish are *Clupea pilchardus,* and if not caught as yearlings to be canned in the familiar manner, head to tail, they may attain a length comparable to that of the Atlantic herring. In Norway there are two kinds. The Grade A sardines are known as *brisling* and are *Clupea sprattus.* The others are called *sild* and are *Clupea harengus.*

The word "sardine" has fallen into confusion. As popularized, the term has come to refer to any small fish that can be canned. To a Californian the word signifies what he calls a pilchard, *Sardinops coerulea,* caught at a size where two cleaned fish may fill a fifteen-ounce can. Such pilchards are caught in purse seines to an annual total of between 250,000 and 500,000 tons, and their market value amounts to at least 19 million dollars. Such fishing methods miss the small individuals and commonly take fish after they have reproduced at least once. Maine sardines, sought close to shore in smaller sizes, are all immature fish. Four to a dozen of them go into a 3½-ounce can; and those that are marketed annually in this way total only slightly over 40,000 tons, but they have a market value about equal to the total output of the California "sardine" industry. With the exception of cod, haddock, menhaden, and rosefish (redfish), more weight finds its way to the fish markets from the herring family than from any other source. Only salmon and tuna exceed the sardine and herring fisheries in value.

Atlantic sardine fishermen usually seek out regions where the fish breed in large numbers and then trap the young as they roam in schools. With so many mouths in a single group, there must be a tremendous demand for food, and sardines are apparently very sensitive to the taste of nourishment diffusing through the water. They will swim toward bait made of the salted roes of cod and other fishes, and they may be induced ("toled" is the word) into traps built of branches driven into mud flats. These are "brush weirs" such as are used extensively in the region around Eastport, Maine, at the Canadian boundary—the center of sardine catching and processing for the Atlantic coast. In a sense, a brush weir is a net made of interwoven plant materials, but the important feature is that it extends into the bottom, and through that bottom the fish cannot escape. In deeper water, a similar enclosure may be achieved through use of a pound net, whose sides are continuous with the bottom. The name refers to the impounding of the catch. Pound nets for sardines are often supported by a circle of floats, and the mesh is fine enough to limit the catch to useful sizes.

Wherever sardines are held captive, the surface of the sea takes on a curious, glittering appearance from countless minute scales. These fish have a poorer hold on their overlapping armament than most, and the mere brushing of one agitated animal against another serves to scrape loose the light-reflecting, tough transparent flakes. Often the scales, like sequins on a dark sea, are clues along the Maine coast to the arrival of a sardine boat—a floating factory more bulky than a finback whale and more destructive to the fish. Sardine boats can be anchored wherever sardines are abundant. Each boat is ordinarily equipped with a special boom from which a funnel-shaped net can be lowered into a passing school of herring. A huge pump on board then inhales a continuous stream of water from the funnel through a six- or eight-inch hose and sucks in sardine and sea together. Both emerge into a pound net on the opposite side of the vessel, the fish to be dipped out and processed at leisure.

Right on board, the fish are finally cleaned and sorted for size. Sea water rinses away the loose particles before the sardines are raised from the tanks on screens to drain. When almost dry, the fish and screens in vertical layers may be lowered into boiling cauldrons of oil—olive oil for high-grade small fish, cottonseed or peanut oil for poorer quality—and when cooked enough they are raised again to drip. Packing in cans requires hand labor, but the work proceeds with amazing speed. The waste parts, meanwhile, are dried as fish meal or manure. The canned fish go to the sardine boat's hold, while bags of fish meal are piled on deck. When sardines are running, several families may live on a single boat for weeks at a time, lending hands for the work and amassing a valuable cargo.

A sardine boat in American waters offers few of the niceties characteristic of the European sardine industry. There the gill nets are dyed blue, supposedly to conceal their meshes from the fish, though also to preserve the fibers. The season must be right for a French sardine to have the proper flavor, and cooking them becomes an art to save the savor and maintain the texture of the meat.

Likewise, the herring along the New England coast can only claim membership in this class of delicacy when quite small. Thereafter, if they escape to live to larger size, they come to the market fresh or dry as "red herring" or slightly salted and smoked as "kippered herring" or "snacks." When larger still, and strongly salted and smoked to cure the meat, *Clupea* becomes a "bloater." Thus modes and methods differ around the world, as do the fish that bear the general name "sardine."

IN THE GLARE of noon the dunes look like a phantom range of snow against the timbered foothills of the Sangre de Cristo

THE Naked Hills

A migrating desert that is urged slowly ever eastward by the force of the winds

By ROBERT M. ORMES

Photos by H. L. Standley

THE dune areas are museums of modern art. Their hills, modeled from pure sand by the wind, have the mysterious quality of abstractions. With none of the customary clothing of plant life and only the slight variations in color provided by light and shadow, they seem too stark for reality. Nowhere in the vast museum of surface geology are the forms so simple and repetitive and yet so endlessly absorbing.

One of the most curious of these areas is the Great Sand Dunes National Monument. Its sands, collected from the shore of a long-forgotten inland sea, now form a baby four-by-ten mile desert in the heart of the Colorado uplands. Their floor is the San Luis Valley, a large flatland 8000 feet above sea level, where crops of potatoes, lettuce, and peas are raised. The valley itself would be a semidesert but for the plentiful supply of artesian water. It is cradled among hordes of peaks that run up to 13,000 and 14,000 feet.

Under the urge of the prevailing wind, the dunes have crept across the valley to its eastern edge. If the present migration continues, they will eventually pile up among the green-timbered foothills of the Sangre de Cristo Range. It requires no more than a moderate

breeze to keep the sand sifting its way upslope, and when the air is strong there is such a multitudinous tinkling of the grains that the whole dune seems to hum with life.

There are two distinct types of sand granules. One kind is a dull tan and nearly spherical. The other particles are smaller and more angular, and they have a wide variety of colors ranging from deep gray to pinks and blues. Assays from various parts have shown a modicum of flour-fine gold but not enough to make recovery worth while.

In the central part the dunes are well over 1000 feet high. In the clear atmosphere they can be seen from 50 miles away. They have brought comments from travelers ever since Zebulon Pike wrote about them in 1807. The numerous artifacts found in the

▲ THE DUNES move eastward in a series of slow cascades

▼ LONG SHADOWS are needed to show the work of the free-hand sculptures of the wind. The ripple marks are dunes in miniature

▲ NATURE, THE SCULPTOR, shapes modernistic-looking mountains in dune-land, and the lines are sharp but never straight

neighborhood indicate that the Indians, too, were attracted to this region.

Odd stories and legends persist about the dune country. One of them is about a troop of web-footed horses that are supposed to course over the sand as fast as if they were on hard ground, because their hooves are widened, overgrown versions of the normal. But we have not yet come by anyone who has seen these horses, and it seems dubious that they could make a living even from the sparse grasses of the periphery. Perhaps closer to the realm of possibility is the sheep story, which states that a shepherd and his whole flock disappeared among the dunes, and likewise the story of two teamsters whose wagon and hobbled mules were swallowed up by quicksand while they slept not far away. If there is any truth in these stories, it seems likelier that they can be explained by a visitation of bandits from Mosca Pass, which cuts through the Sangre de Cristo just west of the dunes and was for some time used as a wagon trail.

Skiers who visit the dunes can have an amusing time. In uphill work they avoid some of the strength-sapping influence of the sand, and with a hard wax they manage to get some good little downhill runs. But the real sport among the dunes is for the visitor who listens to their whispering and plays his eye over their rhythms and undulations.

▲ ONE OF NATURE'S innumerable crystal palaces in the Cascade Mountains of Oregon: a snow-bound stream emerging momentarily to add the music of its waters to the muffled stillness

Winter through the Camera's Eye

By RAY ATKESON

WINTER storms sweeping in from the Pacific Ocean usually mean heavy snowfall in the higher elevations on the western side of the Cascade Range. Indeed, few areas in the world offer such an abundance of snow within a short distance of many large towns and cities. These photographs show several aspects of the fantastic winter fairyland that results.

Until recent years, residents of the Northwest were content to leave the snowbound wilderness in its natural state of loneliness. Now the situation is quite different. Modern highways, kept cleared of snow by giant rotary snowplows, have opened up the Northwest's winter wonderland to visitors bent on a variety of outdoor activities. All along the once snowbound crests of the Cascade Range there are numerous winter playgrounds. Some of the resort hotels nestle snugly in snow fields that are 20 to 25 feet deep.

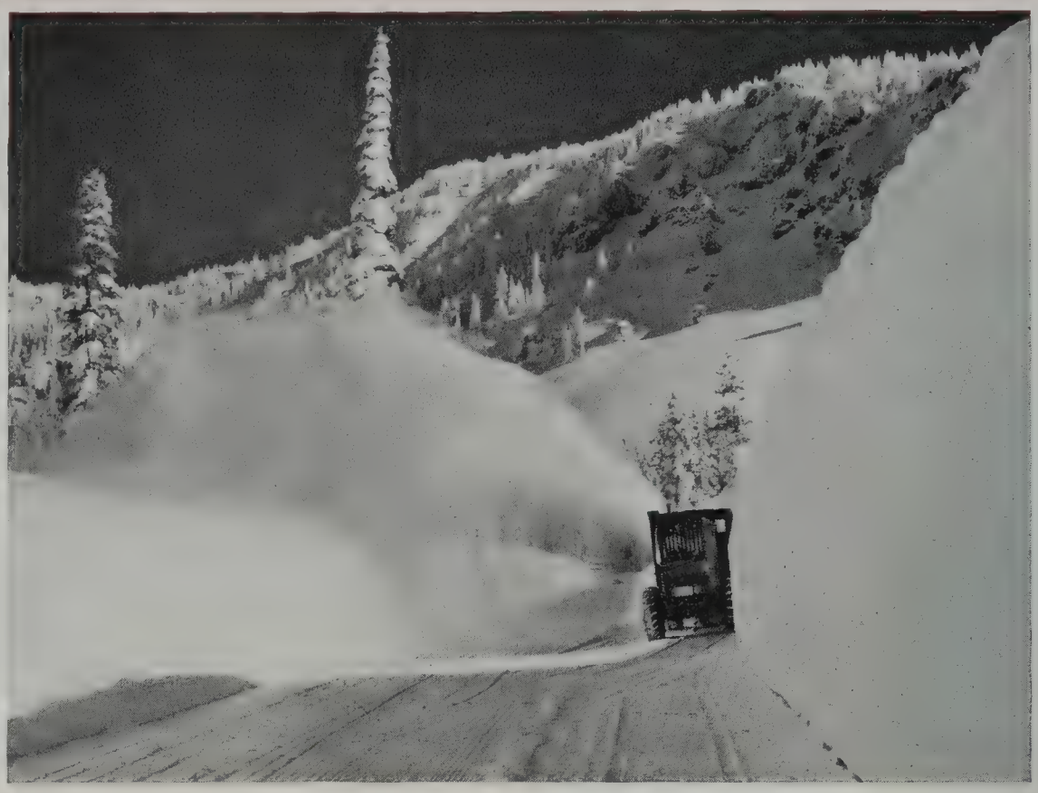
Other persons keep a more serious eye on the work of the winter storm gods. Farmers watch the higher mountain peaks and pray for the deep snows that will ensure moisture for irrigation of crops in the valleys during the dry summer months. And forest officials hope for winter storage of moisture to hold in check the dread fires that sometimes cause such havoc.

The Northwest has finally come to appreciate the value of its snowy heritage.

A SKIER'S DREAM of heaven
mes true in the vast roll-
g foothills of Mt. Baker
Washington

CHRISTMAS-TREE LAND:
t. Hood rising sublimely
yond the spires of the
ergreens

➤ ROARING THROUGH the forests and mountains day and night, a fleet of these giant rotary snowplows battle the element to keep the highway open to the very rim of Crater Lake

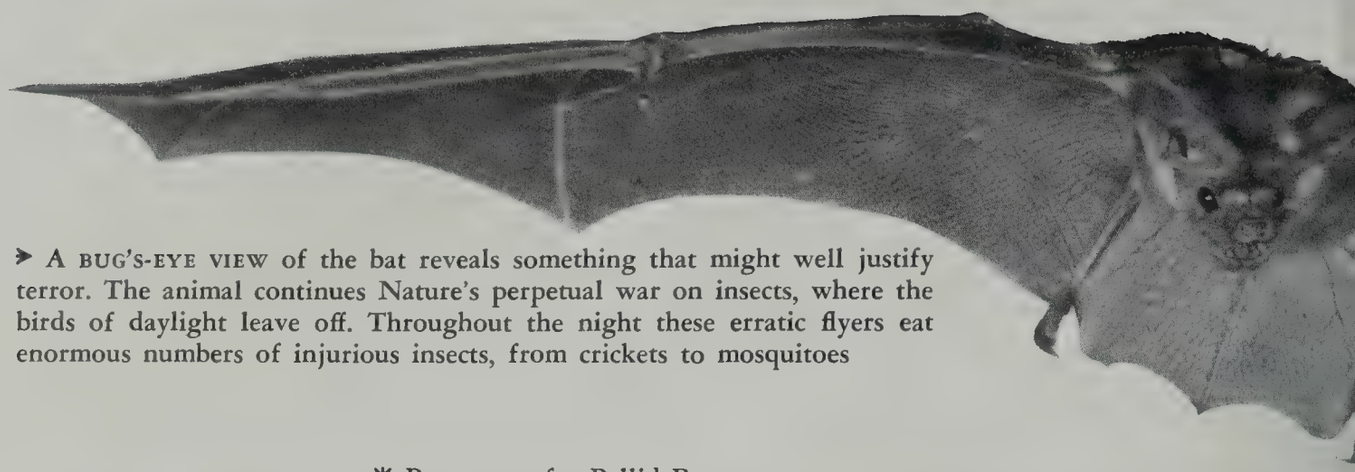


➤ JUST BELOW timber line on Mt. Hood is the Wyieast Club's Ski Hut, nestled in a protected glade in the heavy forest

➤ BENT NOT ON RECREATION but on s
ing vital information, a small grou
hardy men pass the winter measuring
estimating the moisture content of
snow. Many occupations and ways of
are affected directly and indirectly by
reports. The Forest Service makes plan
controlling forest fires; farmers learn
much water they can expect for irrigat
and power plants foretell how care
they must husband their reservoirs
water for the production of electricit

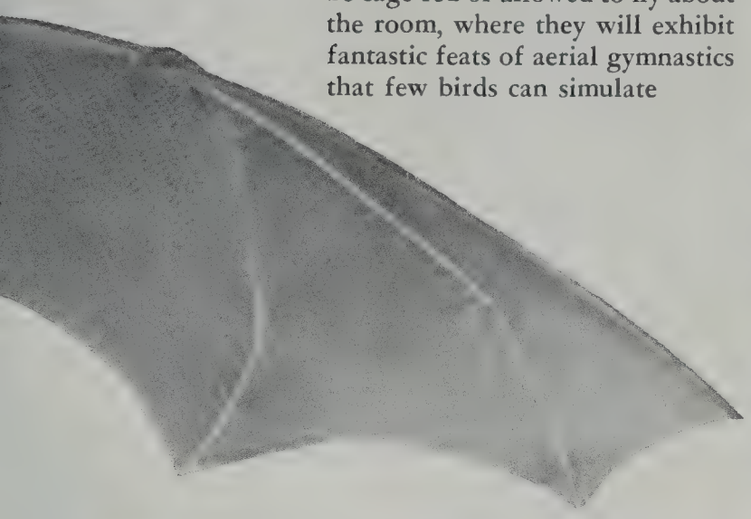
▲ MT. BAKER, lofty snow-mantled monarch of northern Washington, looks down on one of the most beautiful winter playgrounds on the North American continent

◀ WIZARD ISLAND seems to float like a snow-white jewel on the turquoise waters of Crater Lake

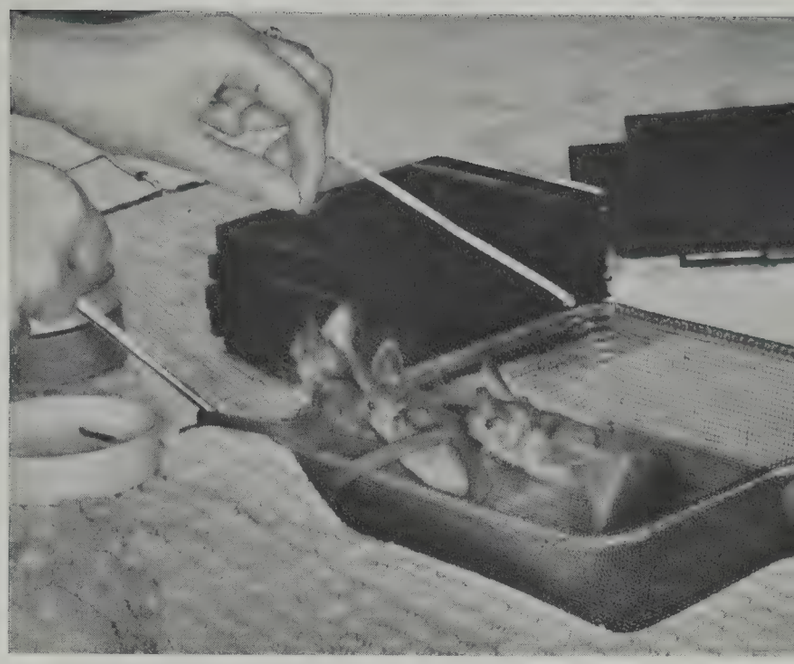


➤ A BUG'S-EYE VIEW of the bat reveals something that might well justify terror. The animal continues Nature's perpetual war on insects, where the birds of daylight leave off. Throughout the night these erratic flyers eat enormous numbers of injurious insects, from crickets to mosquitoes

➤ PORTRAIT of a Pallid Bat



➤ BATS TRAIN easily to come to the hand for food. They can either be cage-fed or allowed to fly about the room, where they will exhibit fantastic feats of aerial gymnastics that few birds can simulate



How Bats Fly

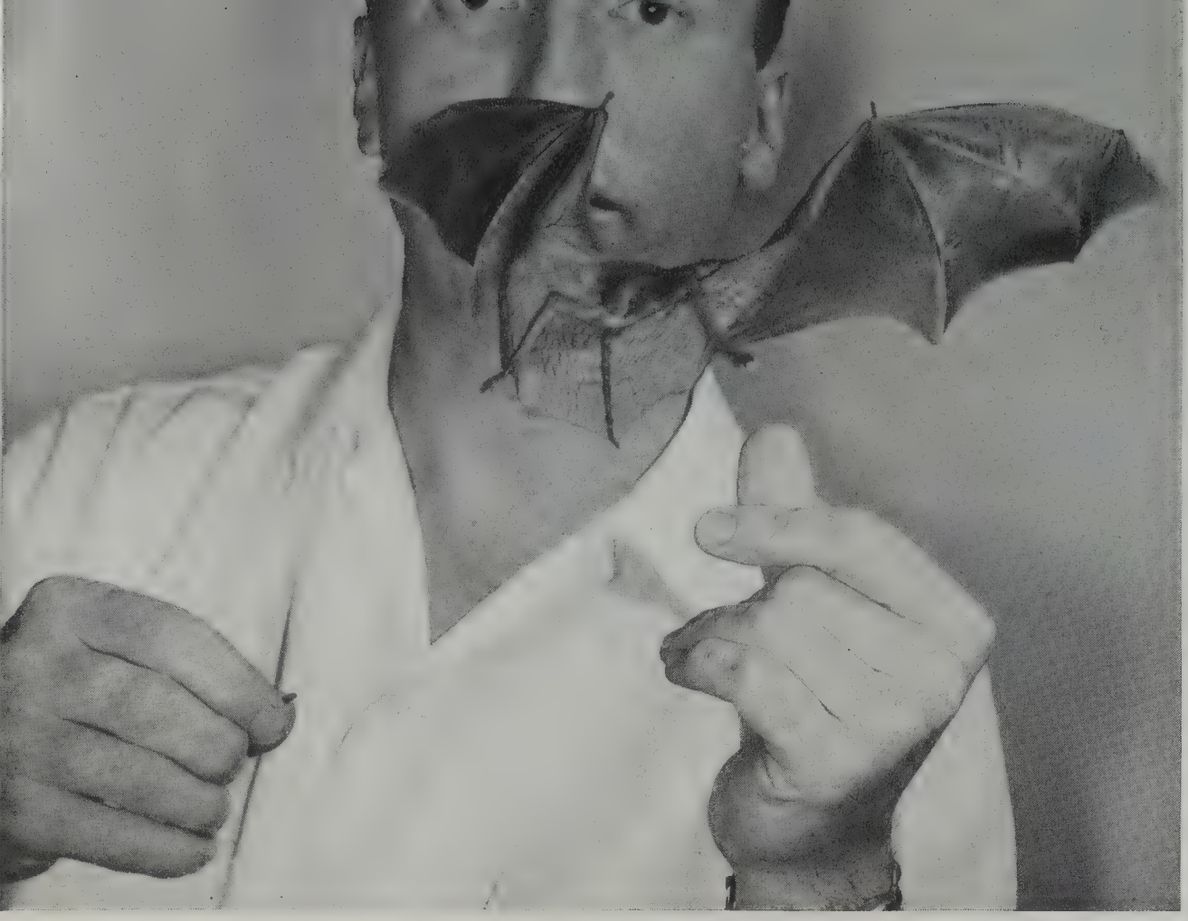
By Richard L. Cassell

One of the most remarkable series of photographs to come from the super-speed camera shows how the only flying mammal maneuvers with consummate skill in a medium it has taken his two-legged cousins centuries to master

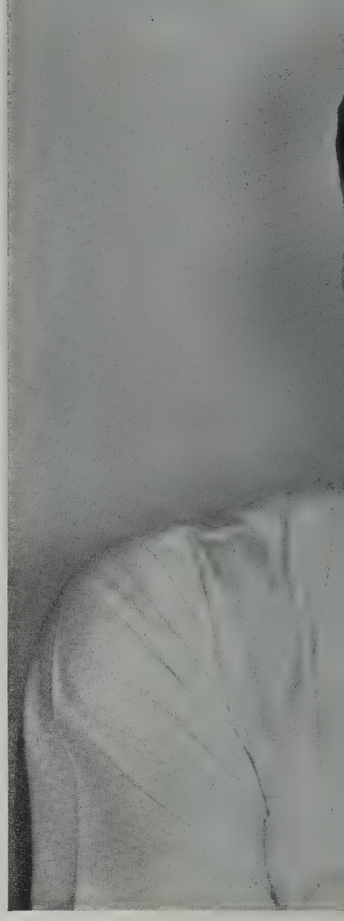
IN all nature probably no other creature is as shrouded in myth, superstition, and misinformation as is the bat. His weird appearance and choice of darkness readily make him an object of false conclusions.

In reality the bat is quite attractive. He will usually become tame in a few hours, showing evidence of affection and intelligence. He is clean, adapts himself to confinement, and soon proves himself not at all the Dracula of the movies or the sinister figure of fiction but a personable character, with traits commendable in any pet.

➤ IT IS INTERESTING to note that individual bats of this group show individual behavior in landing for food. One will have a gliding approach, while the second may flutter in. Another will drop from above, and yet another will exhibit a low, swooping approach in a straight line for a considerable distance



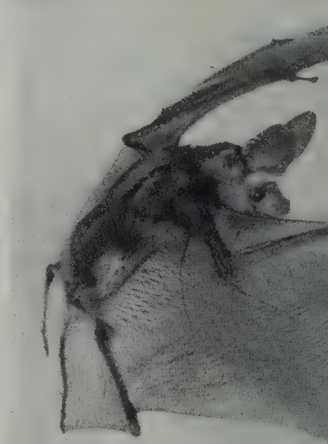
▲ SOUND, NOT SIGHT, seems to be the bat's principal means of perception in determining position, direction, size, and form. Here, the pet bat is guided to the hand for food by the snapping of the fingers. There need be no audible sound. The bat's extremely acute sense of hearing will bring immediate response from any part of the room



▲ GUIDED BY SOUND to th
left hand, Flapper Fanny
handed a beetle larva. Might
Joe hovers above

▲ THEIR DEXTERITY in flight is spectacular in the extreme. A series of supersonic calls, echoing back, warn them of obstacles in their path. But their "space sense" is not infallible. At times, two will try to dodge in the same direction, but no damage results. And at times they will brush a wing against some object. However, they will not crash against windowpanes or lights, as do confined birds and insects

▼ MOST BATS are gregar
and will have a favorite
ing place. In this particular
stance, a picture hanging f
the wall was the choice. H
Mighty Joe "drags the fi
before coming down



➤ DURING FEEDING, traffic jams are frequent and collisions imminent. Often one or more bats will remain clinging to the hands to gobble all the food and obstruct landing facilities for the others. But usually the tidbit will be snatched from the fingers, and flight resumed within a fraction of a second. The fingers may be chewed quite unintentionally in this maneuver, but such bites are infrequent and harmless

Thus modern photography proves that a creature man has disdained has long been the master of some of the finest tricks of aviation skill

➤ LINING UP with the "runway" on the final approach, Flapper Fanny prepares to stall out

➤ THE "TOUCHDOWN" is accomplished by the split-second reduction of wing area. The skirt between the legs pockets the air and reduces forward velocity

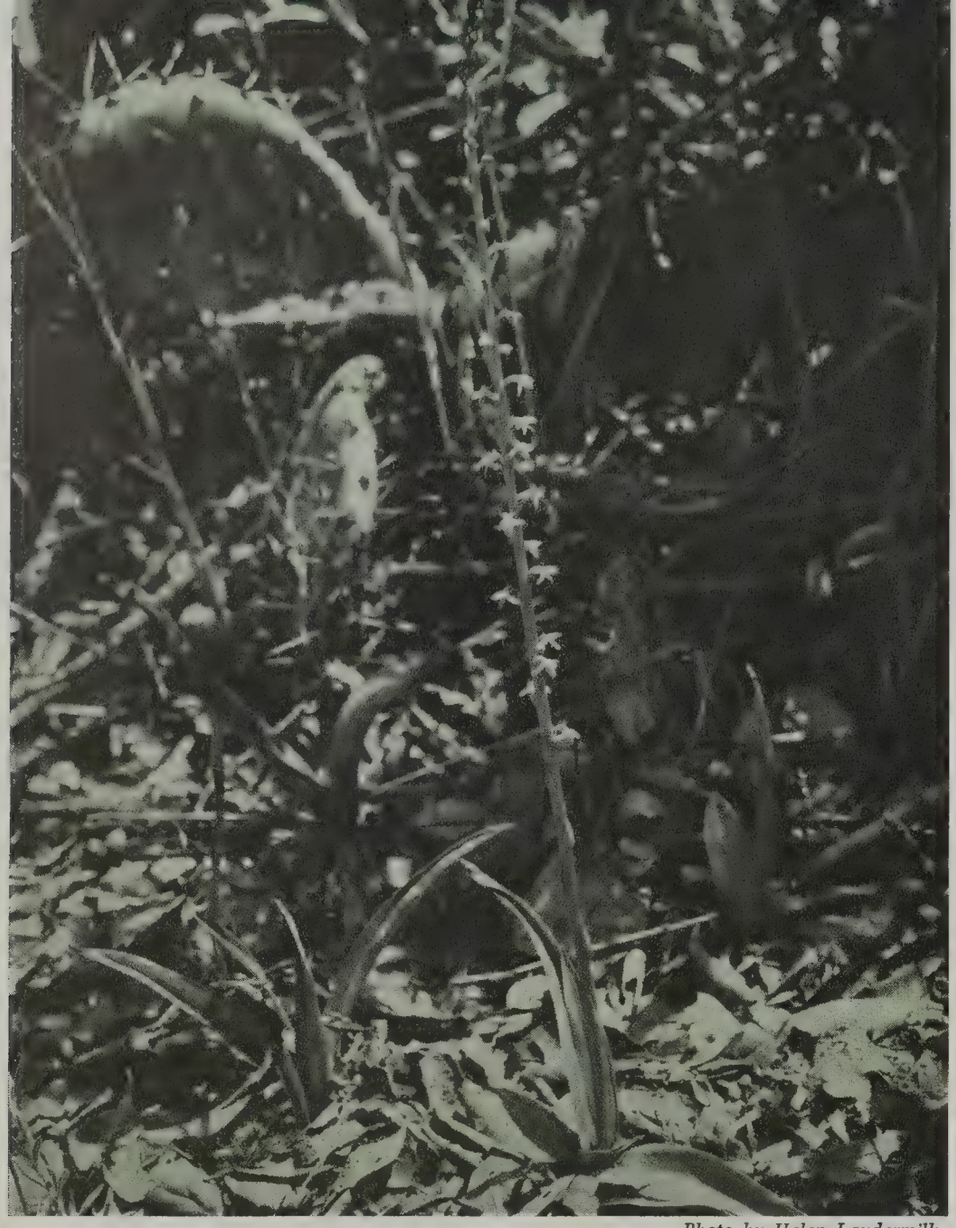


Photo by Helen Laudermilk

◄ THE REIN ORCHIS, *Habenaria unal censis,* which grows as far north as Un laska, is here seen among prickly pe squawbush, poison oak, and other plan of the dry chaparral. Photographed ne Claremont, California

An Orchid of the CHAPARRAL

Its seed is as fine as dust, but the mature flower has a mechanism for pollination that is a marvel to all who have watched it in action

By JERRY LAUDERMILK

Drawings by the author

I WAS on the trail of an elusive orchid. Generally, when a yarn begins like this, it prefaces a jungle saga wherein the explorer staggers through mud, snakes, and mosquitoes in the wake of a treacherous native guide. But the locale and circumstances of this expedition were altogether different. The scene was a dusty stretch of chaparral inhabited by poison oak and devilish red ants that could outsting a wasp. My guide was a sinister and ponderously brilliant student who knew more botany than I and wouldn't laugh at my jokes. But to get on with my story . . .

According to this student – who swore he had collected orchids in the same territory the year before– we were "getting warm." This statement was true according to any of three different interpretations: geographically, physically, or temperamentally. In fact, I had just begun to associate the idea of the piece of clothesline around my plant press with that of the student's fat neck, when he made noises from his post at the head of our two-man safari, indicating that our objective had been attained.

When it came to locating a space about 15 feet square in the middle of 160 acres of chaparral, all of which looked alike, this student was a wonder. Here, on the desiccated slope, hobnobbing with a gang of colorful plant characters known as sotol, prickly pear, buckthorn, and sagebrush, stood about a dozen cool, self-assured individuals of the small, green-flowered rein orchis *Habenaria unalascensis,* which ranges all the way from Unalaska Island in the Aleutians to the south end of California.

Like practically all our native orchids—and about 150 species can be found inside the United States borders—this Habenaria is rare without being actually scarce. It has perfected a knack for keeping out of sight. The plant is green all over, its leaves wither by flowering time, and by early summer it is ready to close up shop for the season without having advertised its stand to any but the dozen or so nature-wise folks in the neighborhood.

Going by externals only, it takes a robust imagination for anybody not initiated into the secrets of plantdom to see any relationship between the unpretentious, greenish-white Habenaria flowers and

those elegant, mauve or shell-pink "creations" that come out of hothouses. But if you look closely with a lens and poke about a bit with a needle, you will soon find that Habenaria's floral architecture holds all the credentials for membership in the illustrious clan of the Orchidaceae.

Orchids have three sepals and three petals. One petal is usually modified out of all proportion to any of the others. This petal is called the *labellum* or lip and is the most obvious of the orchid's peculiarities. In many species the labellum has been fashioned by that old firm of floral architects, "Function & Efficiency," into a highly decorative container loaded with nectar.

This *nectary* or honey-vase is displayed like an advertisement to attract insect customers—and I mean customers instead of guests, because visiting insects have to do a certain amount of work to pay for their refreshment. But I'll come back to this part of my yarn later; right now let's look a little deeper into what a flower must do before it can qualify as an orchid.

Now, the orchids are second cousins to the lilies by way of the irises; and the labellum I just mentioned is actually an upper petal that has been twisted halfway 'round—from the twelve to the six o'clock position—where it functions as a landing strip, restaurant, and signboard all combined. No imagination is needed to see where the twisting has taken place in the Habenaria flower. If you examine it through a magnifying glass, the ovary shows distinct grooves where the twisting took place. And if you will look at the drawing where I have boiled one of the flowers and untwisted it, you will notice that the labellum is now back in its original position as an upper petal. This extraordinary change in the position of the petal, accomplished by twisting, makes possible the insect pollination now to be described.

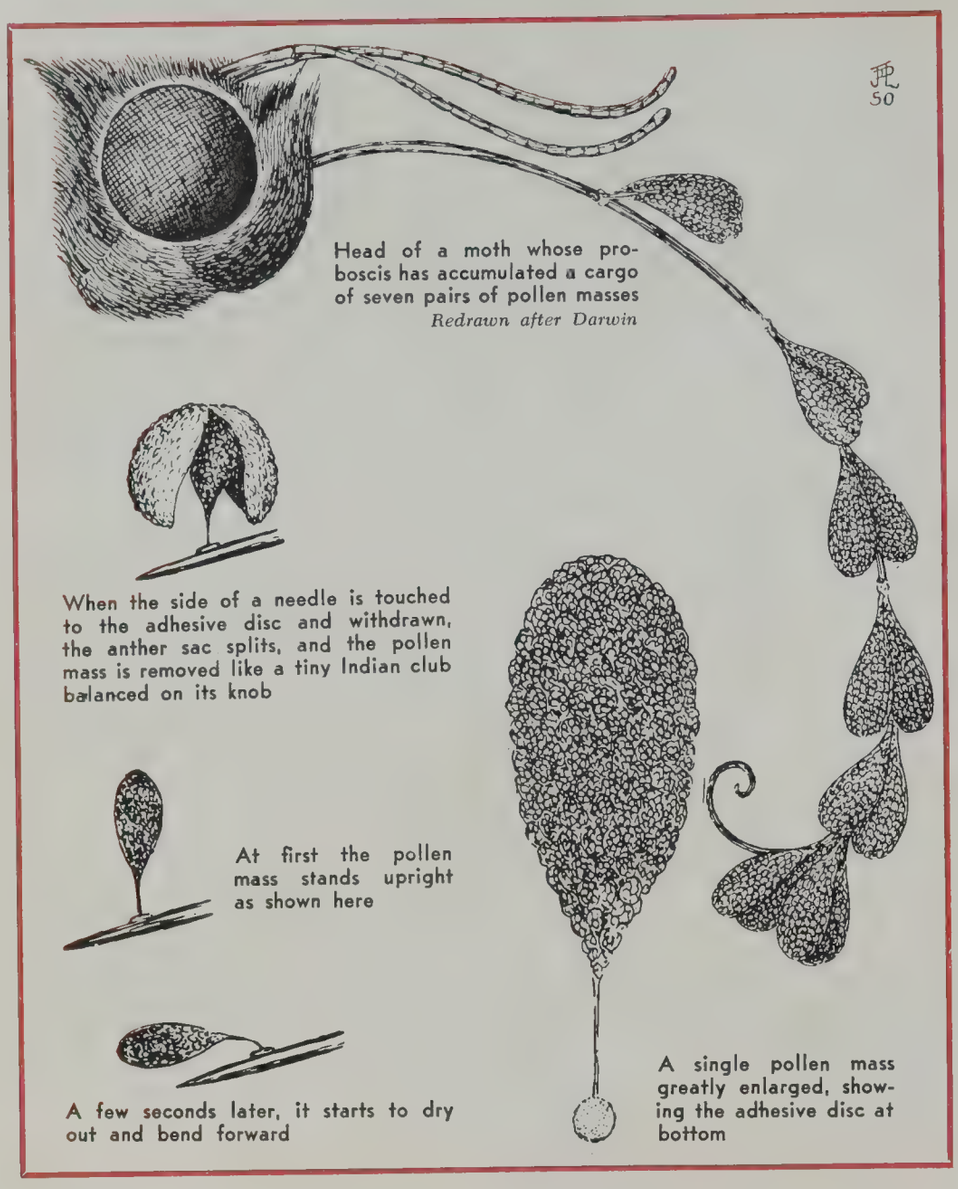
Orchids have specialized in insect pollinization, and nothing has been left to some light-minded insect's fancy. The accommodations are practically foolproof.

To gaze down a Habenaria's

Upper two-thirds of the flowering stalk of *Habenaria unalascensis*, showing the arrangement of the flowers

A single flower viewed from directly in front and enlarged many times

After being soaked in warm water, the labellum can be untwisted as shown here and brought to its "normal" position as an upper petal


Head of a moth whose proboscis has accumulated a cargo of seven pairs of pollen masses
Redrawn after Darwin
When the side of a needle is touched to the adhesive disc and withdrawn, the anther sac splits, and the pollen mass is removed like a tiny Indian club balanced on its knob
At first the pollen mass stands upright as shown here
A few seconds later, it starts to dry out and bend forward
A single pollen mass greatly enlarged, showing the adhesive disc at bottom

throat makes you feel like a Brownie's dentist. Sticking straight out at you like a tongue is the labellum. At the far end of the labellum is the opening to the nectary. Viewed from the outside, this honey-vase forms the dangling spur that reminded some Latin-conscious botanist of the checkrein to a horse's harness. Thus the orchid came to be called the rein orchis or *Habenaria,* from *habena,* meaning "throng" or "strap."

Right above the opening to the nectary—in almost exactly the same location where a normal human throat sports a set of tonsils—you will notice a pair of curious little gadgets. These are the anther sacs, all that evolution has left of the stamens. Here we have two tiny cases filled with pollen; and, unlike the majority of flowering plants, in which the anthers are fastened to the ends of the *filaments* or stamen stalks, this plant has eliminated the filaments altogether and set the anthers snugly against the back of the throat. And, to be of any use in Habenarian society, the pollen enclosed in the anther sacs has to come into contact with the stigma of another Habenaria flower.

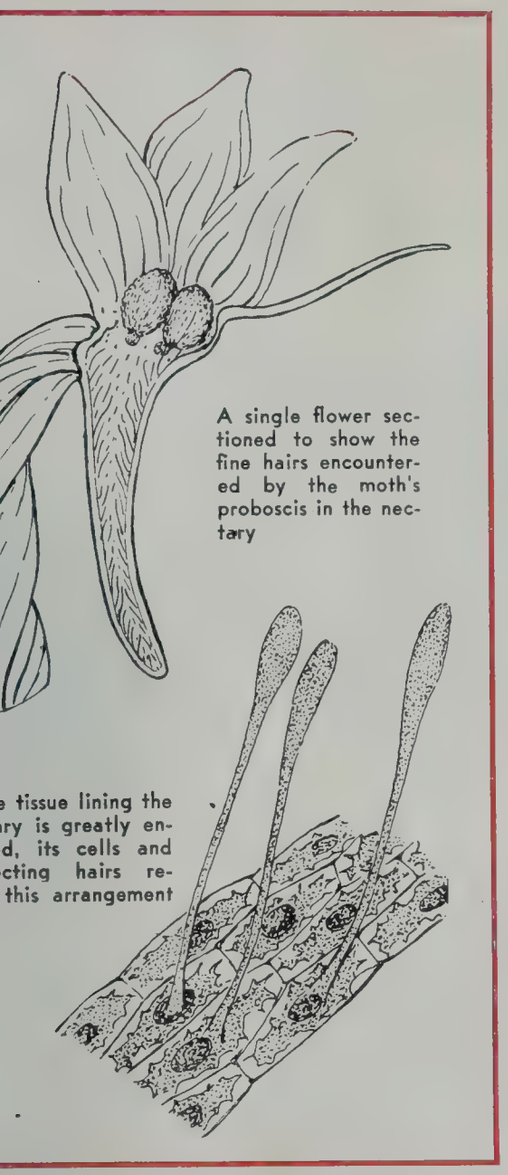
Most flowers have their stigmas in prominent positions, where they can't be overlooked by an insect that drops in for lunch. Sometimes Nature has come very close to comedy in the arrangement of the stigma. In the Iris the trick is done by a tiny, transverse lappet, the *stigmatic shelf,* set at the doorway to the stylar arcade. The stigmatic shelf scrapes off pollen from a visitor's back as neatly as a pickpocket lifts a watch. In the case of the white sage *Salvia apiana,* the style sticks way out beyond the flower where the stigma is bound to tickle the black velvet bolero of the first bee that shows up.

These two cases represent one extreme of stigma organography; the other is shown by our orchid. Here again the flower reduced the stigma to a cluster of specialized cells located just between and below the anther sacs. This is the *stigmatic surface,* and any hit by a pollen grain is successful.

Now, flowers have developed many different systems of seeing to it that pollen reaches the stigma. In some families the wind takes care of the work; these plants throw pollen around like microscopic, yellow confetti on the chance that some of it will land where it will do some good. Some have the anthers and stigmas arranged so that if the plant fails to secure the visit of an insect, it can pollinize itself. This system is popular with some species of *Amaranthus.* Others don't take any chances at all. You find this scheme favored by the ordinary violet.

Most folks would never guess that the violet makes two sorts of flowers on the same individual: the regulation violet flower that depends upon an insect go-between, and an-

A single pollen mass further magnified
spread out to show the packets of pollen jo
in clusters by waxlike strands. A single po
against a black background is barely visibl
the naked eye as a tiny white speck
Greatly magnified, a single pollen packet looks like this



A single flower sectioned to show the fine hairs encountered by the moth's proboscis in the nectary

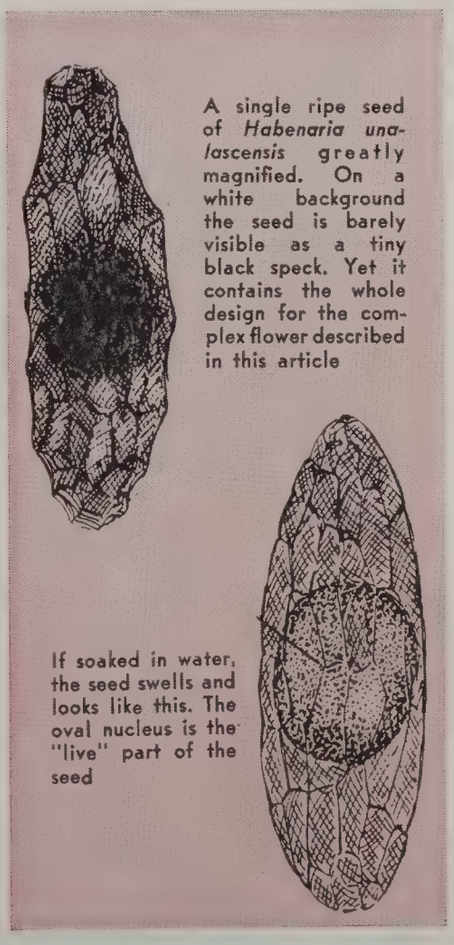
e tissue lining the
ry is greatly en-
d, its cells and
cting hairs re-
this arrangement

other set of flowers few people ever see. These are the *cleistogamous* flowers, which, although entirely self-sufficient, produce perfectly good seed. This system is absolutely risk-free — something like wearing belt and suspenders both at the same time. Finally, the *Yucca* goes to the extreme in insect pollinization. The tiny *Pronuba* moth actually gathers the pollen with her own fair little claws, rolls it into a neat pill, waddles to the top of the stigma, and deliberately rams it into place. The entire process is almost too fantastic for belief.

With our orchid, this concurrence of functions vital to both plant and insect is as astounding as in the yucca scheme. But here the plant instead of the insect seems to take the initiative. Habenaria's pollen supply is sealed up in the anther sacs. Moreover, it comes packaged in neat little clusters tied up with microscopic threads of wax. These clusters are called the *pollinia*, and, since their operation has to be sure-fire, nature and evolution have so engineered things within these microscopic clusters of living cells that at the right time each pollinium will become a tiny, automatic machine.

The fact that the pollinia are scheduled to function—not at once but after the elapse of a few seconds —is just another of those profound facts that make the study of nature worth anything you may have to put into it. What I am now about to describe makes fiction seem colorless, for the actuality takes place by delayed action and the result is as certain as the operation of a time-bomb. It goes like this . . .

In a flower that has not been robbed by a special species of moth, a good magnifier shows that just beneath each pollinium there is a tiny green disc. Each disc has a sticky surface. Barely touch this surface with the finest needle you can get, and the disc clings to the side of the needle with almost intelligent determination. This is the first step in a series of physical and chemical operations that are absolutely necessary for pollination to be effective.



A single ripe seed of *Habenaria unalascensis* greatly magnified. On a white background the seed is barely visible as a tiny black speck. Yet it contains the whole design for the complex flower described in this article

If soaked in water, the seed swells and looks like this. The oval nucleus is the "live" part of the seed

When you pull out the needle with the discs sticking to it, the same action causes the anther sacs to split down the sides, and the pollinia are pulled out standing upright like two microscopic Indian clubs balanced on their knobs.

Now, when the moth comes to sample the nectar, she drinks it through her proboscis—a long, hollow tube fastened to the front of her face. This proboscis is a pump and works like a soda straw. When she shoves it down into the nectary, her head and the upper part of her proboscis are certain to bump against the adhesive discs, which stick and hold fast exactly as they did on the needle. None of this pollen can possibly reach the stigmatic surface of this same flower.

When first pulled out, the pollinia stand upright exactly as they did on the needle. In this position they can't touch anything for a few seconds. It takes the moth quite a while—according to moth time scale—to finish robbing the flower, because the inside of the nectarium is lined with an unusual type of hair. This makes the moth take her time at the job, since she has to thread her proboscis carefully through the barricade before she reaches the nectar. The delay is absolutely essential, for it takes a few seconds for the cement on the adhesive disc to set firmly so that the pollinia will not be displaced in the next series of operations.

By the time the cement has set, the pollinia themselves have dried out, and as they shrink they bend over parallel with the sides of the proboscis and now point straight ahead. By this time the nectary has been thoroughly robbed. The moth pulls out her proboscis and visits a new flower. Here, contact of the pollinia with the stigmatic surface is now as inevitable as no-contact was when the pollinia stood upright. All these fine adjustments and synchronization of time, dehydration, surface tension, etc., are wonderful enough, but there is even more to the story than this.

The stigmatic surface is also adhesive but in a different way from

the discs. Here the stickiness is more of the type you find on a piece of "Scotch tape"; that is, it is a sort of superficial gumminess. If this surface were either more or less adhesive than it is, the whole procession of events would collapse at this point.

Since no single flower needs all the pollen in the pollinia, only enough grains are pulled from the cluster to ensure fertilization. This bit-by-bit donation of pollen continues with each flower visited until the supply is all gone—assuming, of course, that there are flowers enough to take it. This is the point at which the degree of adhesiveness of the stigmatic surface is of supreme importance. If it were less sticky, too few grains would cling to it; if more so, the whole pollinium would be pulled from the moth's proboscis and thousands of grains would be wasted.

All this complicated procedure is directed toward a single end: to make more seeds in order to make more orchids. When I say "more" seeds I mean exactly that. A single flower of one species has been estimated to have produced 1,856,000 seeds. Habenaria can't match this output, but if half the seeds from each plant could grow to maturity, this orchid would soon be as common as grass.

But circumstances are so balanced that such a remarkable situation can't develop. Habenaria seeds are extremely small, only about 1/200th of an inch long. Furthermore, each seed is hardly a finished product, since, unlike the seeds of most plants, Habenaria seeds have no food reserve stored up to give the embryonic orchid a start in life. This means that the seedling has to make good from the start. Unless the conditions of temperature, moisture, soil, and shelter are practically ideal, success or failure for the seedling are separated by a hairline, and it probably has one chance in a thousand. So perhaps the most astonishing part of the Habenaria story is that such an unadaptable little character ever managed to stake out a claim in the dry chaparral in the first place.

THE MYSTERY OF *Twiste*

▼ A LEFTWARD SPIRALING Engelmann's spruce near St. Mary's Glacier in Arapahoe National Forest

Trees

Photo by Cora Heddington

Photo by Cora Heddington

▲ SPIRAL GRAIN is sometimes exaggerated into tortuously twisted forms like this at timber line. A tree on Mt. Evans, in Colorado

Do they reflect the spin of the earth, or the effect of strictly local influences? For centuries, people have wondered—particularly the lumberman, who is cheated by their corkscrew grain

By PAUL M. SEARS

THE homesteader came originally from the plains—from "treeless Texas," as he called it. Here in western New Mexico piñon pines stood around his dry-land farm in a neat open woodland. Trees were good to have about, the homesteader agreed, but these piñons were a sad disappointment. "You can't split 'em," he complained. "The grain twists around like a corkscrew. You start a clean split at one end of the log, and next minute you're hacking into it right *across* the grain. Why they have to grow that way, I don't know."

Neither does anyone else, including foresters who have tried hard to find out. The homesteader was up against a real mystery. Why do some

individual trees, of many species and in many regions, grow with a truly mathematical spiral in the grain of their otherwise quite straight trunks? The question is not idle curiosity. Spiral grain, as the homesteader could testify, is usually an economic liability. More rarely, it can be an asset.

The spiraling of a stately tree trunk is beautiful in its natural geometry, but it is rarely noticed in living forests. Ordinarily only dead trees from which the bark is gone reveal the regular warp-lines winding upward around the trunk and out onto the larger limbs. In burned-over areas in the western forests, where standing, fallen, and half-recumbent dead trees await slow decay, the spiraling is so obvious that it can be measured by systematic surveys.

Thus one forester in Washington State counted 400 such trees in a sample area. All of them showed spiraled grain, making one complete turn, on the average, in about twelve feet of trunk length. More significantly, 96 per cent of them were twisted to the right. Likewise in a stand of alpine fir in Pike National Forest in Colorado, 85 per cent of the trees were twisted to the right. The gnarled apple trees in old orchards, to take another example, are spiraled almost invariably to the right.

This predominance of a rightward twist raises the interesting question of whether trees in the Southern Hemisphere might not be expected to twist mainly to the left. There are some reports that this is so; but unfortunately for the theory, the evidence in our own hemisphere is not consistent: a stand of Douglas fir in coastal Washington near sea level showed twisted grain in only 25 per cent of its individuals, and these were mostly spiraled leftward. Furthermore, among hardwoods, spiraled maples turn mostly to the right, but elms, though usually straight grained, turn predominantly to the left when they do spiral.

Thus we may be reasonably sure that spiraling is something more than a response to the pervasive forces of the earth's rotation. It seems to occur most often where stony soil or harsh climate gives the tree an uphill fight for survival.

Photo by Paul M. Sears

Photo by Paul M

▲ THE STANDING REMNANT of a once-great ponderosa pine

◀ MANY A TWISTING TREE conceals its spiraling grain until the bark falls off, as in the case of this fallen ponderosa pine trunk in the Zuni Mountains of New Mexico

Photo by Cora Heddington

▲ THIS INTENSELY TWISTED TREE at timber line on Mt. Evans shows how complicated the spiraling can become when the branches also are involved

Single trees growing in exposed sites are generally more "tightly wound" than protected individuals growing in near-by forests. Spiraling, once started, grows more intense as the tree grows older.

The contorted tree-forms at timber line in the Rockies are intensely though irregularly spiraled. Not too far below timber line the high altitude forests are composed of trees with fine straight trunks, and here nearly every tree in some stands may be neatly spiraled. Certain high altitude species, such as Engelmann's spruce and limber pine, are noted among foresters for their consistent spiraling.

However, altitude alone does not control spiraling, for stands of Arizona cypress in the Coconino National Forest at an elevation of 4000 feet are as deeply twisted as spruce trees growing at three times that altitude. The twisting of Arizona cypress is often evident in the living tree, where the trunk may be fluted into ridges that twine upward around one another like compound candelabra stems.

The tendency to spiral seems to be partly hereditary. A few extreme cases are definite: for example, Scotch pine seedlings imported from northern Europe grow into useful trees in the United States, but seedlings of the same species from a locality in south Germany produce corkscrew-like trees—freak forms in which twisting affects the straightness of the trunk as well as the grain. Here, two hereditary races of Scotch pine clearly exist.

Because of suspected hereditary factors, foresters in charge of re-

▼ KNOTHOLES interrupt the regularity of the spiraling grain in this ponderosa pine

Photo by Paul M. Sears

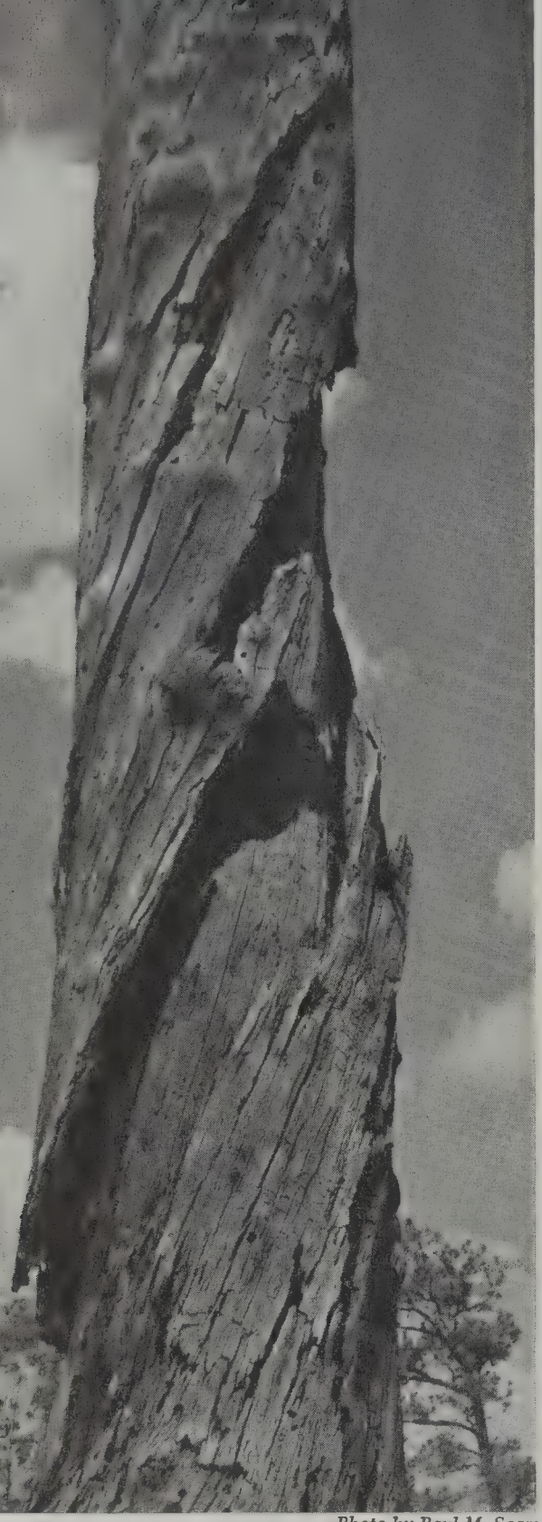


Photo by Paul M. Sears

▲ THIS TREE, 24 inches in diameter at the ground, made a complete turn in 12 feet of trunk length. Where the sapwood has partly decayed, the heartwood shows that the tree spiraled less rapidly when younger. A ponderosa pine one-half mile west of the Continental Divide in the Zuni Mountains of New Mexico

seeding projects try to select seed only from unspiraled trees. This may require cutting into the inner bark of the living seed tree to determine the direction of grain, although in some species, such as Douglas fir, spiraling is often suggested by the trend of the outer bark-ridges.

The desire to propagate straight-grained trees is born of the troubles that spiral grain inflicts on those who would use the timber. Lumber from trees with spiral grain, quite understandably, tends to warp as it seasons. And for structural uses spiraled timber is weaker than straight-grained timber. The degree of weakness depends on the tightness of the spiral; in extreme cases the grain may make a full revolution in as little as two feet of trunk length. One inch of deviation in twenty inches of trunk length is objectionable in structural work, and much more may be disastrous.

Spiraled timber may also split or shatter to pieces in machining operations; Douglas fir and hemlock are particularly bad in this respect. Further disadvantages occur when a long plank from a spiraled tree is planed. Some roughness in the finished board is inevitable, because no matter how the plank is cut, some of its surface will lie across the grain. Fortunately, the softer woods such as ponderosa pine stand sawing and planing quite well in spite of twisted grain, and furnish lumber that can be used wherever strength is not required.

Commercial lumbermen are not the only sufferers from spiral grain effects. The Indians living near Lake Kahnipiminanikok, in Ontario, make their canoe paddles from cedar. The grain must be straight to serve this purpose, and though abundant stands of cedar are available, the trees are nearly all of twisted grain.

It is good to report, by contrast, that occasionally spiral grain has been a providential blessing to man. Notably, the rural plowmakers of colonial America needed, and eagerly sought, the rare hardwood trees of the eastern forests that had a leftward-twisted grain. Such timber accommodated itself naturally to the shape of the moldboard. The tighter the spiral the happier was the plowmaker, for then the plow would not be weakened by cross-grain cutting needed to finish the close curve of a moldboard.

The ultimate complexity of spiral grain appears in some of the tropical hardwoods such as mahogany, which exhibits an "interlocking"

U. S. Forest Service photo

➤ WHEN CLOTHED in bark, it might have looked like a good timber tree. Recumbent, its greatest service is as "nursemaid" to the row of seedlings springing up along one side

grain. Here the direction of spiral is varied from right to left several times during the life of the tree. Such timber is difficult to work, but the effort is rewarding, for these are the exotic woods of the fine cabinetmakers, who prize in their finished pieces the beautiful figure of grain resulting from the alternating spiral.

Many of the strongest and toughest timbers of tropical Australia are heavily interlocked in grain. The karsi *(Eucalyptus diversicolor)* may grow with either straight or interlocking grain, the latter structure producing stronger timber. The maple silkwood of Queensland, when milled, produces a light brown to pink lumber, and the grain may be wavy or curly but is most often interlocking. This jungle tree is one of the best cabinet woods of the world and is a favorite among Australian furniture makers. The grain of some of these tropical Australian woods may interlock at nearly 90 degrees in extreme cases.

Fortunately, you don't have to visit a remote and ruined forest to observe spiral grain; some of the telephone poles in your vicinity are likely to show spiraling. And if you burn seasoned logs in your fireplace, pull the bark away from a few of them. You may uncover a section of one of Nature's barber poles.

THE DESCENT INTO THE BARRANCA DEL COBRE *Continued from page 445*

We moved forward once more on the twelfth, following the torrent, although there appeared no possible way it could pierce the mountain wall ahead. Suddenly the stream turned and dashed at a huge rock, which blocked the view of the mountains beyond. It swung to the right and around the base of the rock. We followed. At the moment of turning, my mule reared backward. And no wonder! Instead of a mountain climb ahead, we were standing on the dizzy edge of a huge canyon, right across our course!

The torrent plunged straight downward into a series of waterfalls for 1500 feet. It was now a raging cataract which roared down the cliff, while the flung spume drifted into the gulf below, a thousand tiny rainbows riding on its spray. The dim trail zigzagged down the hazardous slope, which seemed unnegotiable for mules.

Juan said that the canyon, the Arroyo Hondo, extended miles to the right and left and there was no trail to get around it. We must get across it, and the Barranca was still four days away. Both Paul and Tommy were feeling much better, however, and voted to proceed. I sent Jim and Juan part way down the "zigzag" to see if it were negotiable, for there might be no turning back, with 20 animals.

Jim reported it to be dangerous with uncertain footing, but he thought we might make it. Also, we could turn around at one point. So down we went, our animals sliding most of the way, with the ever-present danger of starting an avalanche. It was a happy moment when we reached the bottom. Since we had started at sunrise, it was now only about 10:30 in the morning, and we paused for a bite to eat. Juan claimed there was a poisonous plant in the stream which would kill the animals, so we hobbled them.

The floor of the canyon was flat like the Yosemite, ½ mile wide, and covered with a magnificent primitive forest of pines, firs, and cedars, untouched by ax or machete. Some of them were 6 feet in diameter and 150 feet in height. Deciduous trees resembling beeches, alders, and even maples appeared in scattered clumps. On the north side the walls were sheer cliffs and ledges, very different from the south slope we had descended. I later found debris from floods at the mouths of caves 50 feet above the normal level of the river; so Jim was correct in his estimation of the terrific power of flash storms in this region. In bushes below the caves I collected a thrush with a bright orange lower bill. It became the type specimen of the Olive-winged Nightingale Thrush[3] which I later described as new to science.

That night, I was awakened by a hoarse, breathy sound, which startled me into thinking a jaguar was preparing to leap. Whirling our giant collecting flashlight on the trees at the base of the cliff, I could locate no animal. Later I was aroused again by a frightening bedlam of growls, coughs, and shrieks such as I had never before heard, emanating from the top of the cliff. It awoke Tom, and he called that it was a large owl! During the following year the type specimen and two other examples of a very rare Stygian Owl were secured by my collector, Chester C. Lamb, in this same mountain range 100 miles to the south.[4] A few months later at the United States National Museum, I imitated its calls to Dr. J. H. Riley and was assured by him that they must have come from a Stygian Owl, as he had heard the same queer sounds from its nearest relative, the Santo Domingo Stygian.

As it was still early afternoon, I decided to essay the climb out of the canyon to Guayachi, where Juan assured us we could obtain tortillas for our *cargadores.* They were growing increasingly surly because we could not produce fresh ones every morning. We soon found ourselves puzzled by a maze of forking canyons. Even Juan lost his way and caused us to retrace our steps, with the loss of two hours time. I did not blame him, for in many places all traces of a trail had been washed away by floods. We finally emerged on a plain covered with pines, where we were assaulted by a truly magnificent thunderstorm that stung us like hail for two hours. Soon ponchos were leaking, and even the mules flinched at the terrific beating. We were glad to reach Guayachi, a small Tarahumare farmhouse in the middle of plowed ground. Cold from the icy ponchos, we hovered over a wood fire on the dirt floor.

The rain ceased, and an ancient Tarahumare told a story of many *guiculos* (wild turkeys) behind the

[3] *Catharus aurantiirostris aenpennis* Moore (Proc. Biol. Soc. Wash., vol. 50, p. 96).

[4] The author described the new race, *Asio stygius lambi,* in the Proc. Biol. Soc. Wash., vol 50, p. 103.

mountain to the east. His offer to prove it at once meant that the day had just begun for me. Never was I so deceived by the deep furrows of an Indian's face. Judging he was at least seventy-five years of age, I imagined I would have no difficulty keeping pace with him, but the Tarahumares are noted for their stamina.[5] He gave me the severest "hike" I ever experienced. It was actually a continuous dog-trot without letup for two and a half hours—down hillsides, over small slippery rocks, or up shalelike slopes covered with treacherous pine needles. If I begged him to halt so I could recover my breath, he would grunt and go all the faster. He wore crude leather *zapatos* tied with deer thongs between his toes. Clearly he despised me! With tongue hanging out of my mouth and heart thumping, I missed a magnificent cock turkey but made a flopping mass of feathers of a female. As I put in a new cartridge, she got on her feet, however, and ran down the hill at great speed. The ancient guide never moved. Obviously he was afraid to run down that slippery hill on his *zapatos!* I decided to take the chance and leaped down at full speed, and I finally secured the turkey. When I returned with her, the Tarahumare let out a curious cry and flung himself into a gnomelike clog dance. Then he rushed up and patted me on the back with many grunts of approval. Evidently I had redeemed myself. But I had an additional reason for excitement. That turkey was another bird new to science! It is now the type specimen of *Meleagris gallopavo onusta.*[6] Heavy rain made us thankful we had raised a tent over our supplies that night.

On the thirteenth, in spite of a threatening thunderstorm, we decided to move on to Chiricahui, from where we might reach the Barranca del Cobre in one long day's safari.

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[5]See "The Tarahumaras — Twentieth-Century Cave Dwellers" by George McClellan Bradt, in NATURAL HISTORY for November, 1948.

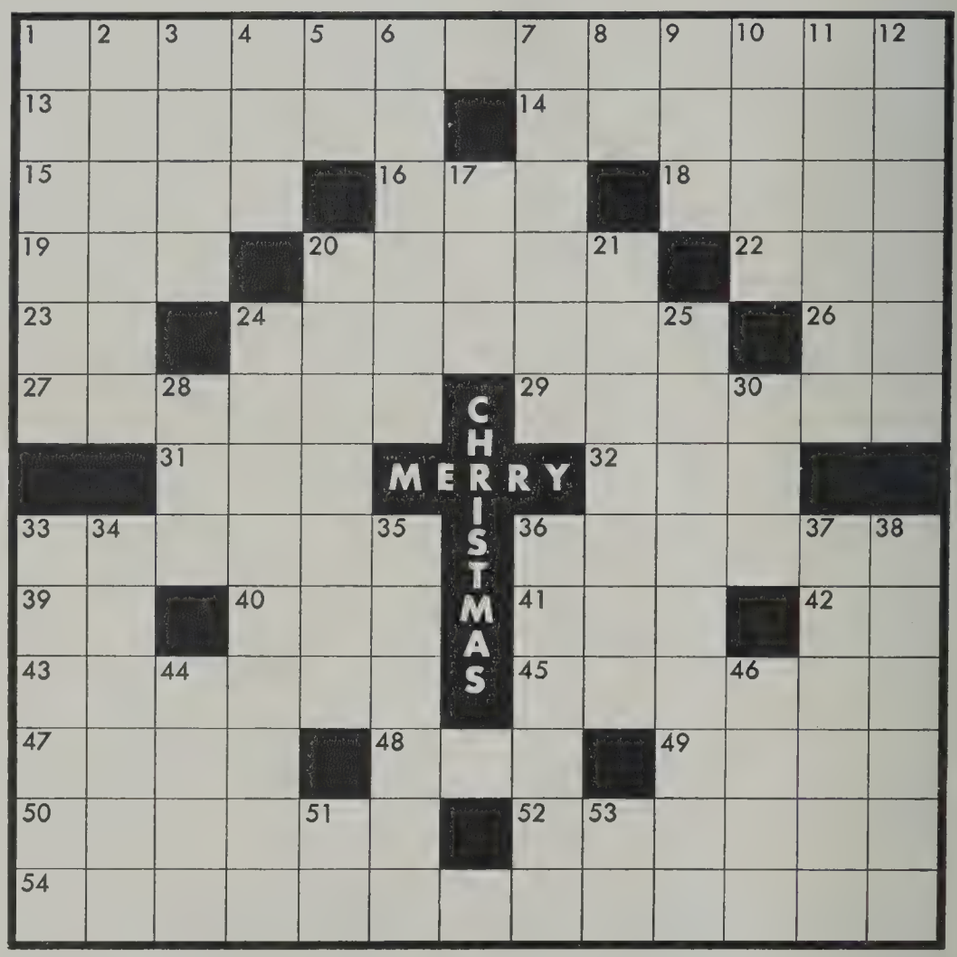
[6]*Auk*, vol. 55, Jan., 1938, p. 112.

(The remainder of the story of the descent into the Barranca del Cobre will be published in the next issue of NATURAL HISTORY.)

Nature Crossword Puzzle

BY ALFRED I. TOOKE

Sharpen up your wits, polish up your brains
And get out your dictionary;
Though some of the words are easy to guess,
Some are quite the contrary.



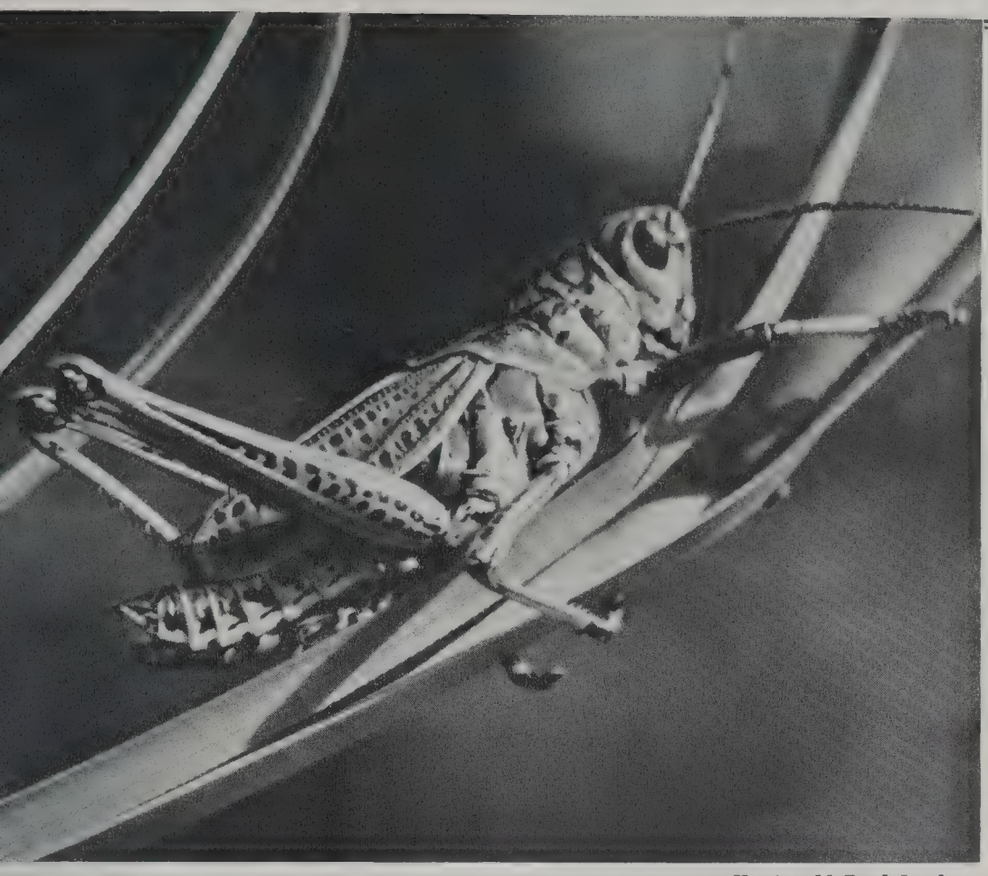
ACROSS:

1. Reptile expert.
13. Rabbit-sized rodent of tropical America *(Dasyprocta).*
14. Inflame with love; charm; captivate.
15. First stomach of a fowl; the craw.
16. Man's best animal friend.
18. Agile, active.
19. Carrion.
20. Any tree or shrub of the genus *Alnus.*
22. The iris.
23. Lieutenant (abbr.).
24. Combed and trimmed with the beak.
26. Missouri (abbr.).
27. A valuable domestic animal found wandering from its owner.
29. One of the Doric race.
31. Member of the Women's Army Corps.
32. Floating water-lily leaf; cushion on cat's foot.
33. A bell jar to protect a plant.
36. To request with authority.
39. Railway (abbr.).
40. Very small bird; also small horse.
41. Suffix used in Latin or Latinized names of groups of animals.
42. Each (abbr.).
43. Something unjudged or undecided (Obs.).
45. Pertaining to the stars.
47. Bluish-white metal in common use.
48. Kind of dirt frogs like.
49. Ninth letter Greek alphabet.
50. Endow with a halo.
52. Time rabbits lay fancy eggs!
54. Instruments for measuring declination of magnetic needle.

DOWN:

1. The neck plumage of the domestic fowl.
2. A heron with white plumage.
3. Part of tree or plant underground.
4. Baby dog.
5. Diminutive suffix.
6. A wren.
7. A fable or myth.
8. Upon.
9. Neither a solid nor a liquid.
10. Mischievous children.
11. A mass of carpels forming a compound pistil.
12. A sting ray.
17. Short poem or song.
20. Genus of food plants that ripen their fruit underground, like the peanut.
21. Opens again.
24. Capable of active use.
25. Playwright.
28. Twice the number of eggs a passenger pigeon always laid.
30. Zoology suffix terminating names of animal groups; also girl's name.
33. Driven insane.
34. Chemical compound derived from boxthorn.
35. Original word root or primitive word.
36. Crown.
37. Tidier.
38. Polish thalers.
44. Royal Naval Hospital Corps (abbr.).
46. Repetition as a method of memorizing.
51. This number written in Roman style.
53. First two vowels.

Solution on page 476



Harrison M. Reed, Jr. photo

➤ AN ADULT LUBBER LOCUST, which uses its wings for talking instead of flying

The Lubber Locust

It is probably the largest member of the grasshopper family in America

By HARRISON M. REED, JR.

THE Lubber Locust, *Rhomalea microptera,* is a pest that farm and home gardeners alike must contend with clear across the southern states and as far west as the Texas border.

Females have a body length of about three inches. With legs and antennae extended, they might measure four and one-half inches. The females seem to outnumber their consorts in a ratio of five to one.

Lubber locusts are often seen walking with an amusing but stately gait across our southern highways during the warmer months, leaving one field of destruction to conquer newer territories. Having a ravenous appetite, they cut their way through the tender parts of plant life, leaving the injured remains behind them, for they are ever on the move. Not content to remain and eat one plant, these giant insects can lay low the choicest row of your garden in a single day. However, there are other grasshoppers that are worse.

Although the lubber locust has wings, it cannot use them for flight, for they are inadequate to support the insect's weight. But nature has given them another use, that of sending and answering the mating call. Under the hard, plastic-like wing cover is a delicately colored pink and red wing that is part of a sound system. The familiar "chit-chit-chit-chit" of a summer day throughout the southland should move the garden and flower lover to search out its origin at once and kill the insect. The male calls in a higher key than the female, because his wings are shorter. The insects hear each other as much as several hundred yards apart and head toward each other, eating ravenously as they go. The lubber locust also makes a hissing sound, by forcing air from the large stigmata near the base of the wings.

The male and female have similar markings and colorings, but the male is much less brilliant. The female is buff-yellow with black markings, and her head, cape, and wing covers are bright red filled in with sunset orange-yellow. Many, however, are nearly black, particularly those north of Florida.

The female lays several batches of eggs in a season, placing them just beneath the surface of the ground, usually in sandy loam, beside some plant that will afford the young their first food the following spring. The eggs are yellow and about the size of large grains of cooked rice.

The young, ranging from 25 to about 60 in a single colony, emerge as tiny black grasshoppers with a bright yellow stripe extending from their cape to the tail end. They display a very interesting habit in their gregarious inclination to move as a body. At dusk, they will be seen to climb the nearest grass blade or weed to roost, all facing upward. Then at daybreak, before it is quite light, they turn in unison and walk down the stem to begin their day's wanderings. At this stage, early in the morning, it is quite easy to tap them off into a pan of kerosene. The wary gardener will save himself much grief if he does this for several mornings, until most, if not all, of the insects have been destroyed.

Under favorable climatic conditions the lubber locust has been known to reach plague proportions. Anyone who has observed one at work gains some idea of what an army of them could do. So, if you love flowers or want to protect the vegetables in your own or your neighbor's garden, kill the lubber locust. He is no friend.

BOOKS

Continued from page 439

There are also 65 smaller, frequently charming sketches of birds, flowers, mammals, and frogs.

More than any other contemporary painter of birds, Menaboni has been influenced by Audubon. The same love of birds in action is evident in the work of both. Menaboni has avoided the excesses occasionally to be found in the paintings of his predecessor but in doing so has allowed his own style to become a bit too facile and polished. His birds have not a feather ruffled; their wing quills in flight stand revealed in the minutest detail, as though caught by the eye of a superspeed camera, not by the human eye. Sleekness becomes a dove, but not an eagle. But this is a comparatively minor fault. Menaboni has a fine eye for composition, and many of his arrangements of small birds among foliage are very beautiful.

The text, which runs to 75,000 words or more, tells in somewhat rambling fashion of the experiences of the Menabonis with birds and of the many pets they have kept as models for paintings. This narrative would have profited by condensation and revision. There is also a short biography of the artist and his wife by "J. S.," who is apparently an official of the publishing firm.

Menaboni's Birds will make a handsome addition to any home library. The great cost of manufacturing colored plates in this country today made its high price inevitable.

DEAN AMADON

Solution to Nature Crossword Puzzle

H	E	R	P	E	T	O	L	O	G	I	S	T
A	G	O	U	T	I	■	E	N	A	M	O	R
C	R	O	P	■	D	O	G	■	S	P	R	Y
K	E	T	■	A	L	D	E	R	■	S	E	G
L	T	■	P	R	E	E	N	E	D	■	M	O
E	S	T	R	A	Y	■	D	O	R	I	A	N
■	■	W	A	C	■	■	P	A	D	■	■	■
C	L	O	C	H	E	■	D	E	M	A	N	D
R	Y	■	T	I	T	■	I	N	A	■	E	A
A	C	R	I	S	Y	■	A	S	T	R	A	L
Z	I	N	C	■	M	U	D	■	I	O	T	A
E	N	H	A	L	O	■	E	A	S	T	E	R
D	E	C	L	I	N	O	M	E	T	E	R	S

LETTERS

Continued from page 434

ican Museum's Department of Animal Behavior:

Wild birds are not likely to lay unfertilized eggs. Egg production is controlled primarily through the activities of the ovary and indirectly by hormones secreted by the pituitary gland. The functioning of the pituitary gland depends to a considerable extent upon various climatic conditions and, secondly, upon a series of behavioral acts commonly known as courtship. During the courtship period females are generally mated and inseminated. Later, when eggs are produced by the ovaries, sperm await them in the oviduct and the eggs are fertilized. If the courtship process is interrupted to the extent that the birds are not inseminated, then it is likely that the ovaries will not be sufficiently activated to produce eggs. Moreover, as soon as a clutch of eggs is laid, the female begins to incubate them, and she becomes broody. This broody condition inhibits further egg production by the ovary. To maintain egg production, as all poultry breeders are aware, the eggs must be collected regularly. Among certain species of wild birds, prolongation of egg production has been induced by removing the eggs as soon as they are laid. For example, a flicker was induced to lay 71 eggs in 73 days. Since the sperm are not likely to remain viable for this length of time, it may be possible to obtain infertile eggs in this manner.

During the process of the domestication of the fowl, breeds have gradually been developed that require less and less courtship behavior to stimulate ovarian activity. Among present-day fowl, a rooster is not necessary to build up or maintain egg production in the hens, and the latter will continue to lay even in complete isolation. In former years it was of definite advantage to the poultryman to be in possession of broody strains because of their ability to incubate a large number of eggs. Now, with the advent of mechanical incubators and chick-rearing devices, this maternal behavior is not only superfluous but a clear disadvantage, since egg production is temporarily suspended. By vigorous selection practices, broodiness has been all but eliminated in the white leghorn.

Fishing with Lights

SIRS:

The discussion on catching fish by artificial light in the October issue of NATURAL HISTORY brings to mind what I observed in Algeciras, Spain, last spring.

The accompanying picture shows the fishing boats that fish in the straits of Gibraltar every night. You will notice that each is fitted with a battery of powerful gasoline lights. I was told that for a considerable period of time, this has been the only means by which successful fishing in the straits could be carried on.

While on the subject of fishing, I noticed an oversized tug equipped with a harpoon gun in the bow, and was told that the straits furnished good whale hunting.

Ottumwa, Ia. GEORGE M. FOSTER

Corrections

The two captions referring to a shrew and a field mouse at the bottom of pages 400 and 401 in the November issue were inadvertently transposed.

In a letter in last month's issue, Mr. J. M. Hollister told how a fish had been taken off the hook by an owl. Between the time when the story left Mr. Hollister's honest care and when it appeared in print, the fish mysteriously grew from ten inches to ten pounds!

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